PB91-101873

Background Document: Toxicity Characteristic Regulatory Impact Analysis

(U.S.) Environmental Protection Agency, Washington, DC

Mar 90

U.S. Department of Commerce
National Technical Information Service
NTIS

PB91-101873

EPA/530-SW-90-088

U.S. EPA Background Document

TOXICITY CHARACTERISTIC REGULATORY IMPACT ANALYSIS

Final Report

March 1990

Prepared for

Economic Analysis Staff
Office of Solid Waste
U.S. Environmental Protection Agency
Washington, D.C.

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

50272-101

REPORT DOCUMENTATION PAGE

1. REPORT NO.
EPA/530-SW-90-088

2.

3.
PB91-101873

4. Title and Subtitle
BACKGROUND DOCUMENT: TOXICITY CHARACTERISTIC REGULATORY IMPACT ANALYSIS
FINAL REPORT

5. Report Date
MARCH 1990

6.

7. Author(s)
OFFI/OSW

8. Performing Organization Rept. No

9. Performing Organization Name and Address

U.S. EPA
Office of Solid Waste
401 M. Street SW
Washington, DC 20460

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address

13. Type of Report & Period Covered
RIA - 3/90

14.

15. Supplementary Notes

16. Abstract (Limit: 200 words)

This Regulatory Impact Analysis (RIA) examines the costs and benefits of an expanded Toxicity Characteristic (TC), which is used to identify hazardous wastes regulated under Subtitle C of RCRA. This document fulfills the requirements of Executive Order 12291, which requires EPA to prepare a RIA for all major rulemakings.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement
RELEASE UNLIMITED

19. Security Class (This Report)
UNCLASSIFIED

20. Security Class (This Page)
UNCLASSIFIED

21. No. of Pages
0

22. Price
0

(See ANSI-Z39.18)

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)

TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY ES-1

CHAPTER 1: INTRODUCTION 1-1

- 1.1 Legislative Framework 1-1
- 1.2 Agency Actions in Response to Statutory Provisions 1-2
- 1.3 Regulatory Options and Final Rule 1-6
- 1.4 Regulatory Analysis Requirements 1-8
- 1.5 Organization of the RIA 1-9

CHAPTER 2: CHARACTERIZATION OF AFFECTED WASTES AND FACILITIES 2-1

- 2.1 Waste Characterization 2-1
- 2.2 Quantities of Waste Exhibiting the TC 2-7
- 2.3 Number of Facilities Affected 2-18
- 2.4 Limitations and Sensitivity Analyses 2-27

CHAPTER 3: COSTS 3-1

- 3.1 Definition of Costs 3-1
- 3.2 Methodology 3-3
- 3.3 Results 3-6
- 3.4 Limitations and Sensitivity Analyses 3-17

CHAPTER 4: ECONOMIC IMPACTS 4-1

- 4.1 Methodology 4-1
- 4.2 Results of Overall Economic Impact Analysis 4-3
- 4.3 Small Business Analysis 4-12
- 4.4 Limitations and Sensitivity Analyses 4-14

CHAPTER 5: BENEFITS 5-1

- 5.1 Methodology 5-1
- 5.2 Results 5-18
- 5.3 Limitations of the Methodology 5-49
- 5.4 Sensitivity Analyses 5-51

REFERENCES

TABLE OF CONTENTS (continued)

APPENDIX A: Used Oil Analysis

APPENDIX B: Derivation of the Maximum and Minimum Scenarios

APPENDIX C: Development of Unit Costs for Waste Management Practices

APPENDIX D: Benefits Modeling

APPENDIX E: Calculation of Plume Areas Using a Simplified Semi-Analytical Method

APPENDIX F: MEI Risk by Constituent

APPENDIX G: Air Emissions from Surface Impoundments

APPENDIX H: Toxicity Characteristic Impacts on the Cost of Managing Industrial Wastewaters

EXECUTIVE SUMMARY

This Regulatory Impact Analysis (RIA) examines the costs and benefits of an expanded Toxicity Characteristic (TC), which is used to identify hazardous wastes regulated under Subtitle C of the Resource Conservation and Recovery Act (RCRA). This document fulfills the requirements of Executive Order 12291, which requires EPA to prepare a Regulatory Impact Analysis for all major rulemakings.

LEGISLATIVE FRAMEWORK

RCRA Section 3001(b) directs EPA to promulgate regulations identifying characteristics of hazardous waste. In response to this directive, the Agency developed the Extraction Procedure Toxicity Characteristic (EPTC) as one of four characteristics of hazardous waste. To determine whether a waste exhibits the EPTC, regulatory levels (maximum concentrations) are compared with constituent concentrations in leachate extracted from a waste during a leaching test, the Extraction Procedure (EP). For wastes containing less than 0.5 percent solids, the waste, after filtration, is defined as the extract. If a concentration in the waste leachate equals or exceeds the corresponding regulatory level, the waste is considered hazardous and is subject to regulation under Subtitle C of RCRA. EPTC regulatory levels were established for 14 constituents of concern, eight of which are metals.

RCRA Sections 3001(g)-(h), which were among provisions Congress added to RCRA with the Hazardous and Solid Waste Amendment of 1984 (HSWA), direct EPA to evaluate and modify the EP and to identify additional hazardous waste characteristics including measures of toxicity. The legislative history accompanying HSWA revealed specific concern for wastes containing organic constituents, noting that organic wastes were rarely encompassed by existing characteristics and that relatively few of such wastes were listed.

THE TOXICITY CHARACTERISTIC RULE

EPA is promulgating the Toxicity Characteristic rule to refine and broaden the scope of the hazardous waste regulatory program and to fulfill specific HSWA mandates. EPA proposed the TC rule on June 13, 1986. The June 13, 1986 Federal Register notice proposed replacing the existing EP with a newly developed Toxicity Characteristic Leaching Procedure (TCLP), adding 38 additional organic chemicals to the list of TC toxicants of concern, and calculating regulatory levels for organics using health-based concentration thresholds and constituent-specific dilution and attenuation factors (DAFs) developed using a ground-water transport model.

The final TC rule retains many of the features of the June 13, 1986 proposal. It replaces the EP with the TCLP, and adds 25 new organic constituents to the list of TC constituents of concern. Regulatory levels for the 25 new constituents, which constitute the nondegrading constituents (i.e., constituents that do not readily hydrolize) among the originally proposed 38, are calculated by multiplying each health-based concentration threshold by a DAF developed using a revised ground-water transport model. EPA has revised some of the health-based concentration thresholds, or Chronic Toxicity Reference

Preceding page blank

Levels (CTRLs), to reflect new data and better methods. The regulatory levels for the 14 existing EP constituents are unchanged.

REGULATORY OPTIONS

The Agency considered numerous regulatory options for the final TC rule. Factors that varied among the different options included the approach for determining DAFs, risk thresholds used for health-based levels for carcinogenic constituents, and the list of constituents to be regulated.

This RIA examines four regulatory options:

- DAF 33,
- DAF 100,
- DAF 250, and
- DAF 500.

The following factors are held constant across all regulatory options examined in this RIA:

- The list of additional regulated constituents comprises 25 organic constituents;
- Risk-Specific Doses (RSDs) are set at 10^{-5} risk level;
- Quantitation Limits supercede calculated Regulatory Levels if the Quantitation Limits are higher; and
- CTRLs are not apportioned among other sources of exposure.

CHARACTERIZATION OF AFFECTED WASTES AND FACILITIES

The Agency characterized the existing, potentially affected universe of wastes and facilities (i.e., the pre-regulatory or baseline scenario) by identifying industries to be examined, accumulating information on the wastes generated by these industries, and identifying current management practices for the wastes.

EPA prepared a series of industry studies for use in the TC RIA. Preliminary studies examined a large number of industries, with emphasis on identifying whether or not TC constituents would be likely to be present in industry wastes. Based on the preliminary studies, EPA completed detailed profiles for 15 industrial sectors. Based on available information, EPA concluded that three of these were unlikely to experience significant impacts under any regulatory option. This RIA presents estimates of the costs, economic impacts, and benefits attributable to the TC for 12 major industrial sectors including over 25 specific subsectors. EPA also considered the possibility that one wastestream that occurs in many industries – used oil – might exhibit the TC.

The majority of wastestreams for which data were available were wastewaters and associated wastewater treatment sludges. The primary data sources for the industry studies were development documents from EPA's Effluent Guidelines program. In addition to analyzing wastewaters and wastewater treatment sludges, EPA also analyzed some solid process residuals and organic liquids. The wastestream characterization data elements used in the analysis were waste type, total quantity of wastestream generated (expressed as metric tons per year (MT/year)), range and distribution of concentrations for each TC constituent in the wastestream, and the number of facilities generating each wastestream. EPA did not have facility-specific information, but rather had characterizations of aggregate wastestreams, each generated by a number of individual facilities.

The Agency used information from its Screening Survey of Industrial Subtitle D Establishments to characterize baseline management practices for wastes under consideration for this analysis. The baseline management practices identified for wastewaters were different types of wastewater treatment prior to discharge under National Pollutant Discharge Elimination System (NPDES) permit or to Publicly Owned Treatment Works (POTWs). The Agency used data from the Screening Survey to estimate the number of facilities that manage wastewaters in Subtitle D surface impoundments, since wastes managed in these units would potentially be affected by the TC. Other facilities managing wastewaters were assumed to be using baseline management practices already compliant with Subtitle C regulations, including management in tanks prior to discharge regulated under the Clean Water Act. These tanks are exempt from Subtitle C permitting requirements (40 CFR 264.1(g)(6)).

EPA identified three likely baseline management practices for sludge or slurry wastestreams: on-site landfilling, off-site landfilling, and on-site land treatment for those wastes suitable for land treatment. For solid residuals, EPA identified two baseline management practices: on-site and off-site landfilling. Baseline management was assumed to occur in Subtitle D units.

The Agency estimated, based on constituent concentration data, the quantity of each wastestream characterized for the analysis that would exhibit the TC. Based on regulatory levels under consideration, the Agency identified a critical concentration for each constituent above which the waste would exhibit the TC. Using a computerized database, EPA compared the concentration range for each constituent in every wastestream with the critical concentration for that constituent. Based on distribution-specific statistical calculations for each constituent, the Agency determined what portion of the wastestream would exhibit the TC solely by virtue of the presence of that constituent. The constituent that resulted in the largest percentage exhibiting the TC was designated the cost-driving constituent. Multiplying the percentage of the wastestream exhibiting the TC by the total quantity of the wastestream yielded the estimated quantity exhibiting the TC. By using this procedure, EPA assumed direct correlation of constituent concentrations, i.e., that the highest concentrations of one constituent are present along with the highest concentrations of other constituents in the wastestream. The Agency tested the sensitivity of results to the direct correlation assumption by adding the percentages of waste exhibiting the TC for each constituent, instead of picking a driving constituent. This sensitivity analysis assumed a perfect inverse correlation.

An additional step was required for wastewaters to determine affected quantity. As mentioned, only some facilities in each industry manage their non-hazardous wastewaters in surface impoundments. Other facilities use management practices that would be compliant with RCRA Subtitle C regulations. EPA multiplied Screening Survey percentages of facilities managing wastes in surface impoundments by the quantities exhibiting the TC to determine the wastewater quantities actually affected by the rule. EPA performed sensitivity analysis on the use of the Screening Survey percentages by alternatively assuming all wastewaters are managed in surface impoundments. This provided an upper bound for the estimated quantity of affected wastewaters.

EPA divided the number of facilities generating each wastestream into large and small facility size categories, using a cutoff of 50 employees to separate large from small facilities. The proportion of "large" and "small" facilities within an SIC was determined using 1982 Census of Manufactures data.

The Agency then estimated the total quantity of each wastestream generated by firms in each size category. EPA assumed that within each size category, all facilities generate the same quantity of waste and that waste generation is proportional to value of shipments. EPA tested the assumption that waste generation by large and small facilities is proportional to value of shipments by alternatively assuming waste quantities were distributed equally between large and small facilities (i.e., 50 percent generated by large facilities and 50 percent generated by small facilities).

To estimate the number of facilities that generate wastes exhibiting the TC, EPA multiplied the number of facilities (in each size category) generating each wastestream by the percentage of the total wastestream quantity that exhibits the TC. The quantity of each wastestream that exhibits the TC was then split evenly (within size category) among the resulting number of facilities. EPA examined two alternative sensitivity analysis assumptions for the percent of facilities potentially affected for each wastestream. First, EPA assumed that if an intermediate percentage (not 0 percent or 100 percent)[1] of a wastestream exhibited the TC, then 10 percent of facilities generating that wastestream were potentially affected. This tended to concentrate larger quantities of waste at fewer facilities than in the initial analysis. Second, EPA assumed that if an intermediate percentage of a wastestream exhibited the TC, then 90 percent of facilities generating that wastestream were potentially affected. These two alternative assumptions provided a reasonable upper and lower bound of a range of affected facilities.

After deriving the number of facilities generating each wastestream that exhibits the TC, EPA accounted for the possibility that single facilities may generate multiple wastestreams that exhibit the TC, i.e., that there may be overlap among the facilities that are generating each separate wastestream in an industry. To account for this overlap, EPA developed two scenarios to assign wastes that exhibit the TC to model facilities: one scenario portrays the maximum number of facilities affected and the other the minimum number of facilities affected. For this RIA, "affected" is defined to mean incurring additional costs as a result of the final TC rule. Affected facilities are all facilities generating either 1) wastewaters that will exhibit the TC and are currently managed in surface impoundments or 2) non-wastewaters that will exhibit the TC.

---

[1] Clearly, if none or all of a wastestream exhibits the TC, then no facilities or all facilities are affected by the rule because of that wastestream.

EPA qualitatively addressed the impacts of the TC on generators and handlers of used oil. Used oil is generated across a wide variety of industrial sectors, and analysis of impacts is complicated by the fact that it has economic value and can be sold in intermediate or end-use markets. Test data were not available to determine whether used oil would exhibit the TC. Used oil may not fail the TC because of its oily consistency. In order to develop worst-case estimates of quantities of used oil that may exhibit the TC, EPA assumed that used oil would pass through the TCLP filter.

COST AND ECONOMIC IMPACT METHODOLOGY

EPA analyzed the incremental costs of the TC final rule in terms of both social costs and compliance costs to industry (expressed as revenue requirements). Social costs are the total costs of an activity minus any transfer payments (e.g., taxes, above-average profits). Compliance costs measure the income that must be generated by an affected party to offset newly incurred costs and maintain the same level of profit; these include transfer payments. Incremental costs were calculated by subtracting baseline waste management costs from post-regulatory waste management costs for model facilities. Baseline waste management practices were identified during the characterization of affected wastes and facilities. EPA predicted post-regulatory waste management practices by assuming that a generator would choose to manage wastes in the most economical manner available to the generator.

Post-regulatory costs for wastewaters in this analysis are based on the cost of management in tanks exempt from Subtitle C requirements. EPA also examined costs of underground injection and dilution as potential compliance practices, but did not assign these costs to any facilities because the estimated costs were significantly higher than for management in exempt tanks.

EPA examined on-site Subtitle C landfills, on-site Subtitle C land treatment, and off-site Subtitle C commercial facilities as post-regulatory options for sludges, slurries, and solid residuals. The Agency included the costs of complying with relevant RCRA requirements for owner/operators in its analysis of on-site Subtitle C waste management costs. In addition to incorporating normal operating expenses for Subtitle C management, the Agency also incorporated the costs for RCRA corrective action. Based on information in the Corrective Action RIA,[2] the Agency assumed that approximately 31 percent of all new Subtitle C facilities would trigger corrective action at some point in time. Approximately 12 percent would trigger corrective action immediately and 19 percent would trigger corrective action sometime in the life of the facility. The remaining 69 percent of the facilities would not trigger any corrective action and were not assigned corrective action costs. The cost model predicted that the vast majority of model facility owner/operators would select off-site management over on-site management.

To gauge economic impacts, EPA compared compliance costs with average facility costs of production and with cash from operations, using financial data obtained primarily from the Census of Manufactures and Annual Survey of Manufactures. The Agency used two ratios to identify facilities likely to experience adverse economic impacts: compliance cost divided by cost of production (the COP ratio) and cash from operations divided by compliance cost (the CFO ratio). The COP ratio represents the percent product price increase for facility output that would be necessary of the entire compliance cost, accompanied by facility profit, were to be passed through to consumers. The Agency criterion is that a COP ratio of five percent or greater indicates a significant adverse economic impact. The CFO ratio represents the number of times that a facility's profit would cover the compliance cost if the facility were to fully absorb the cost. For this ratio, EPA considers a value of less than 20 to represent a significant adverse impact. A CFO ratio of less than 2 represents the potential for facility closure.

---

[2] Draft Regulatory Impact Analysis for the Proposed Rulemaking on Corrective Action for Solid Waste Management Units, ICF Incorporated, September 1988.

BENEFITS METHODOLOGY

EPA examined three measures of benefits of the TC final rule. These measures were reduction in human health risks, reduction in resource damage, and reduction in groundwater cleanup costs. The methodology for estimating these benefits had two major parts. EPA first determined the adverse effects resulting from the unregulated management of wastes (i.e., baseline management). Then, EPA determined which of these adverse effects would not be present if the wastes were regulated under the TC (i.e., post-regulatory management).

EPA used simplified models of waste management for the baseline and post-regulatory cases. In the baseline, EPA assumed that wastewaters are managed in surface impoundments and non-wastewaters are managed in landfills or land application units. All baseline units are assumed to be new, unlined units. To analyze the regulatory options, EPA assumed a regulated waste is properly managed in Subtitle C units and that proper management results in negligible risk, resource damage, or clean-up cost. Under the regulatory options, baseline damages are assumed to be eliminated when a waste is regulated.

EPA characterized each potential TC wastestream by the constituents in each wastestream expected to cause the greatest carcinogenic and non-carcinogenic risk (i.e., risk-driving constituents) and the number of facilities managing the wastestream. EPA used this information in a Monte Carlo model that combined information on the distribution of waste characteristics with information on the distribution of environmental and exposure conditions associated with managing these wastes, and calculated the risk and resource damage resulting from their management. The model produces exposure concentrations and plume areas which reflect the variations in TC wastestream concentrations and in hydrogeologic conditions. In the model, leakage from a facility is immediate and the effect of the leakage is measured in terms of steady-state contaminant concentrations and contaminated plume areas in the underlying ground water. The transport of constituents is based on EPA's ground-water transport model, EPACML, and on data from EPA's Municipal Landfill Survey.

Human health risk was measured in terms of risk to the most exposed individual (MEI) and population risk. MEI risk was based on the constituent concentrations at the closest downgradient well, if one was present. If downgradient wells were not present, there was no exposure and no MEI risk. Based on information from the Municipal Landfill Survey, 54 percent of the managing facilities do not have downgradient wells. For those facilities with downgradient exposure, carcinogenic and non-carcinogenic MEI risk were estimated from the lifetime daily doses of the constituents, calculated from the exposure concentrations.

Population risk was estimated for those scenarios with downgradient wells (i.e., 46 percent of the scenarios). Population risk was based on the number of people affected by the contaminated plume and was calculated separately for exposure to carcinogens and non-carcinogens. Carcinogenic population risk was estimated in terms of the expected number of cancer cases. This was determined by estimating the average individual risk resulting from the contaminated plume and multiplying it by the affected population. Non-carcinogenic population risk was estimated in terms of the population exposed above the Reference Dose (RfD) for the constituent. The Referense Dose is the dose above which adverse effects are expected to occur. Based on the plume area which exhibits a dose above the RfD, EPA estimated the number of people exposed above the RfD. EPA assumed a population density of 1.6 people per acre, based on the Municipal Landfill Survey, in estimating carcinogenic and non-carcinogenic population risk.

Resource damage measures the cost associated with replacing contaminated ground water that had been used as a source of drinking water. The resource damage estimates were based on the costs of designing and constructing an alternative water supply which meets the demand of the population located in the area with contaminated water. The contaminated plume area is defined by constituent concentration thresholds, above which the water is unsuitable for use. EPA used constituent thresholds based on drinking water standards (i.e., MCLs) where they exist and, alternatively, the lower of taste and odor thresholds or health-based thresholds (with the health-based thresholds limited by detection limits).

To estimate cleanup costs avoided, EPA assumed that a portion of the facilities managing TC wastes will require cleanup efforts. Without TC regulation, cleanup at these sites will likely fall under public programs (either at the state level or under Superfund). With regulation, the number of facilities requiring such cleanup is reduced. EPA investigated the cleanup costs avoided due to TC regulation for a range of potentially affected facilities using an average cleanup cost of $15 million per site. EPA used an average value due to the lack of information relating the extent of contamination to cleanup costs at a site. The average value results from an examination of data from 14 Superfund Records of Decision (RODs). The RODs were selected to reflect sites at which TC constituents are the primary constituents of concern and ground water is the primary contaminated medium. EPA also assumed that any cleanup efforts would occur fifteen years in the future and discounted the cleanup costs accordingly.

AFFECTED WASTES AND FACILITIES RESULTS

Exhibit ES-1 summarizes quantities of wastes and numbers of facilities affected under the four regulatory options. The quantity of waste that would be affected by the rule ranges from about 660 million metric tons (MMT) per year under the DAF 500 option to approximately 840 MMT per year under the DAF 33 option. For all four options, wastewaters account for over 99 percent of the total affected waste quantity. While large quantities of wastewaters may be affected by the TC, these wastewater quantities will not necessarily be brought into the Subtitle C system. This RIA predicts, based on cost analysis, that handlers of wastewaters affected by the TC will choose to switch from

EXHIBIT ES-1

TOTAL QUANTITIES OF WASTE AND NUMBER OF FACILITIES AFFECTED BY THE TC RULE

Regulatory Option	Total Quantity Affected (MT/yr)[a]	Number of Facilities Affected (Minimum to Maximum)
DAF 33	840,000,000	17,000 - 19,000
DAF 100	730,000,000	15,000 - 17,000
DAF 250	700,000,000	14,000 - 16,000
DAF 500	660,000,000	14,000 - 16,000

---

[a] Wastewaters constitute over 99 percent of total quantities affected.

anagement in surface impoundments to management in tanks exempt from Subtitle C requirements. Most of the waste under each of the options is generated by large facilities. A total of 13 constituents appeared as "cost-driving" constituents in the analysis. For the DAF 100 option, benzene was the driving constituent for over 60 percent of the affected waste quantity. Other constituents that appeared as cost-driving constituents were vinyl chloride, carbon tetrachloride, chloroform, trichlorethylene, 2,4-dinitrotoluene, tetrachloroethylene, methyl ethyl ketone, pentachlorophenol, chlorobenzene, heptachlor, 2,4,6-trichlorophenol and nitrobenzene. The other 12 constituents analyzed did not appear as driving constituents, although they were present in wastestream data. These constituents did not appear as driving constituents but could have been present in wastestreams for which another constituent was the driving constituent.

The total number of facilities affected for the different regulatory options ranged from about 14,000 (minimum number affected under DAF 500) to 19,000 (maximum number affected under DAF 33). Under the most stringent option (DAF 33), about 15,000 to 16,000 small facilities and about 1,900 to 2,600 large facilities would generate wastes affected by the rule. Under the least stringent option (DAF 500), approximately 13,000 to 15,000 small facilities and 700 to 1,100 large facilities would be affected by the rule.

COST AND ECONOMIC IMPACT RESULTS

The total annual social costs of the rule, expressed in 1988 dollars, range from approximately $52 million for DAF 500 to $270 million for DAF 33. The social costs of the DAF 100 option are $190 million per year and for DAF 250 are $67 million per year. The total annual costs to industry (compliance costs) range from about $82 million for DAF 500 to approximately $350 million for the DAF 33 option. Compliance costs more than double from DAF 250 ($110 million) to DAF 100 ($250 million). Cost and economic impact results are summarized in Exhibit ES-2.

The vast majority of compliance costs (over 90 percent) incurred by industry are concentrated over 5 or 6 industrial sectors (depending on the DAF option): Petroleum Refining; Pulp and Paper; Wholesale Petroleum Marketing; Synthetic Fibers; Organic Chemicals; and Pharmaceuticals. The Petroleum Refining industry incurs the largest costs of any industry under the DAF 33 and DAF 100 options. Wholesale Petroleum Marketing incurs the largest costs under the DAF 250 option, and Synthetic Fibers incurs the largest costs under the DAF 500 option. Large facilities incur 80 to 90 percent of the total costs to industry. Although the quantity of waste exhibiting the TC is driven by wastewaters, the cost of complying with the TC rule is driven by sludges, slurries, and solid residuals due to the significantly higher incremental costs for managing these non-wastewaters.

Benzene was the driving constituent for wastestreams that account for at least 70 percent of total costs for DAF 100 and 80 percent of total costs for DAF 250. Chloroform, vinyl chloride, and carbon tetrachloride are the other notable cost driving constituents for these two options. Costs can not be strictly attributed to the driving constituents in wastestreams, because it is possible that other TC constituents are also present along with the driving constituents.

Facilities affected by the rule that choose to land dispose wastes on-site will require permit modifications (if they are currently Subtitle C treatment, storage, or disposal facilities)

EXHIBIT ES-2

COSTS OF THE TC RULE AND ECONOMIC IMPACTS*

Regulatory Option	Social Cost ($ million/yr)	Compliance Cost ($ million/yr)	Number of Establishments with Significant Impacts
DAF 33	270	350	86
DAF 100	190	250	65
DAF 250	67	110	29
DAF 500	52	82	29

* Costs and economic impacts do not reflect the costs of Subtitle C closure of surface impoundments; see Section 3.4.9 for discussion. They also do not reflect the reduction in costs that would result if oily wastes do not fail the TC.

or will have to seek new RCRA Subtitle C permits. Some facilities treating or storing TC wastes (but not disposing of them) may also require permit modifications. EPA estimated the potential number of industrial facilities seeking permit modifications or new permits under the four regulatory options. Under the least stringent regulatory option (DAF 500), the Agency would expect up to 130 permit modifications and 17 new permit applications. Under the most stringent regulatory option (DAF 33), the Agency would expect as many as 230 permit modifications and 260 permit applications. The number of Subtitle C commercial TSDFs seeking permit modifications could be as high as 360, the estimated number of existing commercial TSDFs. Results are presented in Exhibit ES-3.

The number of establishments possibly facing significant impacts under the regulatory alternatives ranges from 29 (DAF 500) to 86 (DAF 33), as shown in Exhibit ES-2. No facility closures are anticipated as a result of the regulation. The industries containing establishments that may have significant economic impacts under the regulatory options presented are Pulp and Paper; Synthetic Rubber; Cellulosic Synthetic Fibers; and Organic Chemicals. Under none of the regulatory options do 20 percent or more of small businesses suffer significant impacts.

Three end-use management practices for used oil may be affected by the TC rule: road oiling, dumping, and landfilling/incineration. The largest affected quantity was that associated with landfilling/incineration (approximately 405,000 metric tons per year), followed by dumping (374,000 MT/year), and road oiling (232,000 MT/year). If used oil were to become hazardous under the TC, it would probably be shifted to other end-use management practices such as rerefining, burning as fuel, and possibly management in a Subtitle C landfill. The shift in management practices would impose costs on used oil generators, the used oil management system (intermediate collectors and processors), and end-users of used oil.

BENEFITS RESULTS

Exhibit ES-4 summarizes results of the benefits analysis. A brief discussion of results for each benefits measure examined follows.

Number of additional cancer cases in 70 years. There are 5.6 cases of cancer predicted in the baseline case. These are divided roughly evenly between wastewaters and non-wastewaters. The most stringent option (DAF 33) avoids all of these cancer cases. DAF 100 and DAF 250 eliminate nearly all the cases. The least stringent option (DAF 500) reduces the baseline figure by 93 percent; the residual risk is due to non-wastewaters.

Number of facilities with cancer risk to the most exposed individual exceeding 10^{-5}. In the baseline case 790 facilities are estimated to pose cancer risks greater than 10^{-5}. Non-wastewaters account for 62 percent of that amount, and benzene more than 90 percent. While the most stringent regulatory option brings all 790 facilities beneath the 10^{-5} threshold, the less stringent options provide lesser degrees of protection. The DAF 500 option reduces the baseline value by 58 percent (with nearly all of the residual due to non-wastewaters); the DAF 250 option reduces that value by 92 percent; a DAF of 100 provides a 99 percent reduction.

EXHIBIT ES-3

PERMIT MODIFICATIONS AND APPLICATIONS*

Regulatory Option	Potential Permit Modifications**	Potential Permit Applications
DAF 33	51 to 230	260
DAF 100	45 to 220	180 to 190
DAF 250	3 to 220	15 to 17
DAF 500	3 to 130	15 to 17

---

* Industrial facilities only. The number of Subtitle C commercial TSDFs seeking permit modifications could be as high as 360.

** Low end of range includes only disposal permit modifications; high end of ranges includes potential treatment and storage permit modifications.

EXHIBIT ES-4

SUMMARY OF BASELINE RISK AND REGULATORY BENEFITS FOR ALL WASTES*

Benefit Measure (units)	Baseline Risk	Benefit for Regulatory Option**			
		DAF 33	DAF 100	DAF 250	DAF 500
Cancer cases (Number of cases) Over 70 years	5.6	5.6	5.5	5.5	5.2
Facilities with cancer risk > 10E-5 (Number of Facilities)	790	790	780	730	460
People exposed to non-carcinogenic constituent concentration >RfD (Number of People)	320	320	320	320	320
Facilities with non-carcinogenic constituent exposure > RfD (Number of Facilities)	8.2	8.2	7.6	5.7	5.7
Resource Damage (Billion Dollars)	3.8	3.8	3.8	3.6	2.4
Facilities with Resource Damage >10E6 dollars (Number of Facilities)	1600	1600	1600	1600	1600

* Benefits estimates do not reflect the benefits from Subtitle C closure of surface impoundments. They also do not reflect the reduction in benefits that would result if oily wastes do not exhibit the TC.

** All regulatory option results are reported as reduction from baseline risk (i.e benefit).

Number of individuals exposed to non-carcinogens at levels above the reference dose. In the baseline case, there are 320 individuals with exposures that exceed the reference dose for non-carcinogenic substances. All of the regulatory options prevent all of these exposures. Over 70 percent of the baseline cases are due to pentachlorophenol, and nearly all are associated with exposures from wastewaters.

Number of facilities with exposures to non-carcinogens for the most exposed individual exceeding the reference dose. Exposures exceeding the reference dose for non-carcinogens are predicted to occur at 8.2 facilities in the baseline.[3] Nearly 70 percent of these facilities appear because of pentachlorophenol, and more than 70 percent are due to exposures from wastewaters. The most stringent regulatory option brings exposures at all facilities below the reference dose level. The less stringent options (DAFs 250 and 500) provide only 70 percent of this protection, and do not bring maximum exposures below the threshold for any of the facilities that appear in the baseline because of non-wastewater exposures.

Resource damage. Resource damages in the baseline case are estimated to be $3.8 billion. Non-wastewaters comprise 63 percent of that amount, and benzene is the constituent responsible for 95 percent. While the most stringent regulatory options reduce resource damage by nearly 100 percent, the least stringent option provides only a 63 percent reduction and leaves $1.4 billion in damages (essentially all from non-wastewaters.) In contrast, the DAF 250 option reduces baseline risks by 95 percent, and the DAF 100 option reduces the baseline value to essentially zero.

Number of facilities with resource damage exceeding $1 million. In the baseline, 1600 facilities are predicted to have resource damages exceeding $1 million. Almost all of these cases are eliminated by any of the regulatory options presented in this document. (About 2 percent of the non-wastewater contribution to the baseline remains under the DAF 500 option.) The baseline cases are about evenly divided between wastewaters and non-wastewaters, and 94% are attributable to benzene contamination.

Cleanup costs avoided. EPA estimates avoided cleanup costs at $15 billion for DAFs 33 through 500. This represents the full baseline value for such costs, and reflects the fact that even the DAF 500 option reduced resource damage below the $1 million cutoff for substantially all facilities. Due to the simplified nature of this analysis, there is significant uncertainty associated with these estimates.

COMPARISON OF COSTS AND BENEFITS

The Agency used cost and benefit estimates to compare relative costs and benefits of the various regulatory options. Analyses were conducted separately and were not meant to be used to produce absolute measures of cost effectiveness. Also note that it is difficult to commensurate the timeframes associated with costs incurred and benefits accrued. Exhibit ES-5 shows the present value costs of the rule along with benefits analyses results for the various measures of benefits. ES-6 presents MEI cancer risk reduction, population cancer risk reduction, and resource damage reduction in "per dollar" terms, obtained by dividing

---

[3] Fractional facilities, like fractional cancer cases, are statistical projections produced by the methodology and are not meant to be taken literally.

EXHIBIT ES-5

PRESENT VALUE COSTS AND BENEFITS OF REGULATORY OPTIONS[a]

Option	Compliance Cost (Present Value Millions of 1988 Dollars)[c]	MEI Cancer Risk Reduction (Reduction in No. of Facilities Exceeding 10^{-5} Risk)[b,h]	MEI Non-Cancer Risk Reduction (Reduction in No. of Facilities with RfD Exceedances)[b,h]	Population Cancer Risk Reduction (Annual Reduction in No. of Cases)[b,d]	Population Non-Cancer Risk Reduction (Reduction in No. of Exceedances)[b,e,h]	Resource Damage Reduction (Annualized, Millions of 1988 Dollars)[b,f]	Cleanup Costs Avoided (Annualized, Million of 1988 Dollars)[b,g,i]
DAF 33	5,200	790	8.2	5.6	320	3,800	15,000
DAF 100	3,700	780	7.6	5.5	320	3,800	15,000
DAF 250	1,600	730	5.7	5.5	320	3,600	15,000
DAF 500	1,200	460	5.7	5.2	320	2,400	15,000

---

[a] Due to analytical uncertainty, the cost and benefit estimates are more useful in comparing the relative costs and benefits of the regulatory options than in measuring the absolute costs and benefits of the options.

[b] The different benefits measures are overlapping and should not be added.

[c] Social costs incurred over 20 years. Estimates were made as ranges; high end of range is presented. Costs are total costs for all waste types.

[d] Cancer cases incurred over 70 years.

[e] Non-cancer exceedances based on 70 year exposure.

[f] Resource damage incurred over 200 years.

[g] Cleanup costs incurred over 30-year period of cleanup.

[h] MEI risk and non-carcinogenic population risk are based on a 70-year exposure. They are not present value benefits.

[i] Due to simplified nature of this analysis, there is significant uncertainty associated with these estimates.

EXHIBIT ES-6

COST EFFECTIVENESS OF REGULATORY OPTIONS BASED ON PRESENT VALUES[a]

Option	MEI Cancer Risk Reduction per Million Dollars (Reduction in No. of of Facilities Exceeding 10^{-5} Divided by Present Value Compliance Cost)[b,c]	Population Cancer Risk Reduction per Million Dollars (Reduction in Present Value No. of Cases Divided by Present Value Compliance Cost)[b,d]	Reduction in Resource Damage Per Million Dollars (Reduction in Present Value Resource Damage Divided by Present Value Compliance Cost)[b,e]
DAF 33	.15	0.001	$0.73 million
DAF 100	.21	0.002	$1.0 million
DAF 250	.46	.003	$2.3 million
DAF 500	.38	.004	$2.0 million

---

[a] Social costs incurred annually over 20 years.

[b] The different benefits measures are overlapping and should not be added.

[c] MEI risk is based on a 70-year exposure; it is not a present value benefit.

[d] Cancer cases incurred over 70 years.

[e] Resource damage incurred over 200 years.

each benefit by total present value cost estimates for the regulatory options. The discount rate assumed in present value calculations is three percent.

LIMITATIONS

Some important limitations of the analysis would tend to underestimate costs and economic impacts of the rule:

- Some industries and wastes (e.g., contaminated soil, off-spec products, contaminated debris) not addressed by the RIA may be affected by the TC.
- Some costs that may be incurred by certain facilities are not included, such as costs for TCLP testing.
- Additional costs for closing surface impoundments as Subtitle C units will be incurred by some facilities. EPA examined an upper bound cost and economic impact scenario by assuming the additional costs will be incurred by some facilities.

One major limitation may overstate costs and economic impacts of the rule:

- Oily sludges in the Petroleum Refining, Wholesale Petroleum Marketing, and Petroleum Pipelines industries may not pass through the TCLP as readily as non-oily wastes; thus, in reality, oily wastes may not exhibit the TC as predicted. To generate lower bound estimates of costs and economic impacts, the Agency assumed that no oily non-liquid wastes will exhibit the TC.

Other limitations create uncertainty, and may either understate or overstate costs nd economic impacts. Since the Agency did not have facility-specific information, there a substantial amount of uncertainty associated with the average unit costs used. Furth assumptions were necessary in the characterization of affected wastes and facilities, :he absence of facility-specific information. There were four important areas where assun ions were necessary:

- Estimating quantities of waste exhibiting the TC;
- Assigning management practices;
- Distributing affected waste quantities to large and small facilities, and
- Estimating the number of facilities affected by the TC.

In addition, there are uncertainties inherent in estimating health risks, resource damage and cleanup costs. Several limitations may underestimate benefits of the rule:

- The benefits analysis focused on exposure only via the groundwater medium.

- Some industries and wastes (e.g., off-spec products contaminated soils, and contaminated debris) not addressed in the RIA may contribute to benefits.

- Other benefits measures, such as ecological risks, were not included.

- The risks estimated in this analysis take into account only the twenty-five constituents now considered for inclusion in the TC rule. Additional risks and resource damage may be expected to result from co-controlling other constituents in wastestreams regulated by this rule. Also, the characterization of each wastestream by a single risk driver for cancer risks and a single risk driver for non-cancer exposures may have masked significant contributions to risk by other contaminants included in the same wastestream.

- The current analysis assumes that the TC RIA database accurately reflects the wastes and wastestreams that will exist upon promulgation of the TC rule. It neglects the powerful stimulus that the TC rule may provide for facility owner/operators to enhance pollution prevention efforts. Pollution prevention has merit on its own. Procedural changes to adopt less hazardous substitute chemicals or to begin closed-loop recycling would also reduce the health impacts and resource damages associated with current patterns of chemical use.

- As an upper bound for compliance costs, EPA assumed that some facilities managing wastewaters in surface impoundments could not switch to tank management by the effective date of the rule, and would incur additional costs for Subtitle C closure of surface impoundments. Benefits for such closure, and possibly for bringing additional facilities into the Subtitle C system and subjecting them to RCRA corrective action, were not included.

Other limitations may overstate the benefits of the rule:

- The methodology assumes that all risk and resource damage observed in the baseline may be avoided under post-regulatory conditions.

- Oily sludges may not filter in the TCLP and, therefore, may not exhibit the TC as predicted.

- Wastewater benefits are based on concentrations in surface impoundment influents and do not account for potential constituent loss through volatilization.

- The steady-state model does not consider the volume of waste being managed at any particular facility. Assuming that the contaminated plume grows immediately leads to overestimates for risk and resource damage because it may take many years for contaminant plumes to reach equilibrium size. Moreover, if insufficient contaminant quantities are actually present in a particular facility, there may not be sufficient mass of the contaminants to reach the equilibrium plume size.

- The health benefits portion of EPA's methodology does not consider the possibility of detection and response to groundwater contamination. Taste and odor problems may alert populations at risk, or State or Federal monitoring programs may detect the contaminated plume. If contamination is discovered, residents may switch to bottled water or formal corrective action procedures may be initiated.

- The steady-state model used to develop estimates for the size of contaminated ground-water plumes does not consider the possibility of discharge to surface water. Particularly in the humid East, water tables tend to be close to the surface and contaminant plumes may be truncated by the discharge of contaminated groundwater to the surface. This suggests that the plume sizes used in the current analysis may be overestimates, and that estimates for carcinogenic population risk, non-cancer population exposure, and resource damage may also be overestimated.

General uncertainty arises from some assumptions used in the analysis. These assumptions may either understate or overstate benefits. There are several areas where assumptions were necessary:

- Using environmental and hydrogeologic data from municipal landfills to represent Subtitle D industrial facilities;

- Using uniform population densities for determining population risk and resource damage.

- Estimating the number of facilities managing TC wastes.

- Assigning potency factors for toxic constituents.

- Using median hydrogeologic environment to calculate plume areas.

SENSITIVITY ANALYSES

With limited information available, the Agency concentrated on gathering data necessary to quantify the major impacts of the TC rule. In many cases, assumptions were necessary in order to conduct this RIA in the absence of specific information. The Agency conducted sensitivity analyses on major assumptions including assumptions made to estimate waste quantities exhibiting the TC, to distribute waste quantities to large and small facilities, to estimate numbers of facilities affected, to estimate wastewater quantities manged in surface impoundments, to predict the behavior of oily wastes in the TCLP, and to calculate costs associated with TC wastewaters currently managed in surface impoundments.

Sensitivity analysis showed that cost results are very insensitive to the driving constituent assumption (i.e., assuming direct correlation of constituent concentrations) used to estimate quantities of waste that exhibit the TC. For most wastestreams either (1) only the driving constituent is present at levels above the TC regulatory levels, or (2) most of the wastestream would exhibit the TC by virtue of the driving constituent.

When EPA assumed, in order to establish an upper bound for quantities of affected wastewaters, that all wastewaters are managed in surface impoundments, affected wastewater quantities increased substantially. However, since non-wastewaters drive the cost of the rule, cost estimates were not as sensitive to this assumption. Under this assumption, total social costs of the rule increased by approximately ten percent. The increase in costs did not substantially affect economic impacts.

Using the 50/50 (portion of waste generated by small/large facilities) distribution assumption as an alternative to assuming distribution proportional to value of shipments, social costs of the rule increased by a little over five percent. Compliance costs to industry generally decreased for large facilities and increased significantly for small facilities. In conjunction with small facilities generating larger waste quantities and incurring higher costs under this assumption, there were greater economic impacts for small facilities.

Instead of linking the estimate of the number of facilities affected to the percentage of waste that exhibited the TC, the Agency assumed (1) that 10 percent of facilities are affected and (2) that 90 percent of facilities are affected. The analysis was much more sensitive to the first alternative assumption (set intermediate percentages to 10 percent) than to the second (set intermediate percentages to 90 percent). For many industries, wastestreams driving costs were exhibiting the TC in very large percentages. This resulted in comparatively low sensitivity to the 90 percent assumption. Setting intermediate percentages to 10 percent reduced the total social costs of the rule by approximately 50 percent, while setting intermediate percentages to 90 percent resulted in only a one percent decrease. Compliance costs to industry decreased very significantly under the 10 percent assumption, especially for large facilities. For small facilities, the decreases in compliance costs ranged from negligible in certain industries to approximately 25 percent in others.

When the Agency assumed that no oily non-liquid waste will exhibit the TC, lower bound annual compliance costs estimates were $130 million for DAF 100 and $66 million for DAF 250. Under the upper bound assumption that some facilities will incur additional costs for waste managed in surface impoundments, total annual compliance costs were $400 million for the DAF 100 option and $260 under DAF 250.

Only one of the sensitivity analyses described above would have significant implications in terms of the benefits of the rule. Assuming that all facilities generating wastewaters manage them on-site in surface impoundments would increase the number of managing facilities substantially. Accordingly, the number of facilities causing MEI risk equal to 10^{-5} or greater, RfD exceedances, or resource damage greater than $100,000 would also increase. Baseline resource damage and cleanup costs for wastewaters would increase significantly.

EPA also examined the assumption that only 46 percent of facilities managing wastes on-site have downgradient drinking water wells. By assuming that all of the facilities were upgradient of wells, the Agency determined that the benefits would be larger by a factor of approximately two.

CHAPTER 1

INTRODUCTION

This Regulatory Impact Analysis (RIA) for the final Toxicity Characteristic (TC) Rule submitted in accordance with requirements of Executive Order 12291, presents the costs and the benefits of options considered by EPA in developing the TC Rule.

This chapter outlines the development of the Toxicity Characteristic (TC) Rule from the original directive issued by Congress in Section 3001 of the Resource Conservation and Recovery Act (RCRA) to EPA's final analysis of regulatory options for the TC Rule. The chapter is divided into five parts. The first section reviews the legislative framework supporting the identification of wastes as hazardous based on intrinsic characteristics of the waste. The second section summarizes the actions taken by EPA in response to Congressional mandates within RCRA and the Hazardous and Solid Waste Amendments of 1984 (HSWA) to identify wastes as hazardous based on the characteristic of toxicity. The third section provides a general description of the regulatory options for the TC evaluated by EPA within this RIA, as well as other options considered by the Agency. The fourth section identifies the requirements that the Agency must satisfy in evaluating the impacts of the TC rule. The final section outlines the organization for the rest of the RIA.

1.1 LEGISLATIVE FRAMEWORK

In Section 3001(b) of RCRA, Congress directs the EPA Administrator to "promulgate regulations identifying the characteristics of hazardous wastes." RCRA Section 3001(a) further specifies that the criteria for identifying characteristics for hazardous wastes should take into account such factors as "toxicity, persistence, and degradability in nature, potential for accumulation in tissue, and other related factors ..." In response to this directive, the Agency developed the Extraction Procedure Toxicity Characteristic (EPTC) (40 CFR 261.24). The established test method for this indicator of a waste's toxicity is the Extraction Procedure (EP), a laboratory test of the potential leachability of specific constituents from a waste. For solid wastes, the EP exposes the waste to a liquid leaching medium; if the leachate from the test contains any regulated constituents at or above a constituent-specific Regulatory Level (RL), the waste is deemed a hazardous waste due to its EP toxicity. For liquid wastes, the waste is filtered and constituent concentrations in the filtrate are compared to the constituent-specific RLs.

In HSWA, Congress further refined its position regarding the identification of a waste as hazardous based on characteristics of the waste. Congress added RCRA Section 3001(g), which directs the Administrator to "examine the deficiencies of the extraction procedure toxicity characteristic [EPTC] ... and make changes ... as are necessary to insure that it accurately predicts the leaching potential of wastes ..." HSWA also contains language charging the Administrator with "identifying additional characteristics of hazardous waste, including measures or indicators of toxicity." [RCRA Section 3001(h)]

Thus, HSWA requires the Administrator to expand the list of characteristics identifying wastes as hazardous. In response to the HSWA directives to (1) evaluate and modify the

EPTC, and (2) expand the list of characteristics used to identify a waste as hazardous, EPA proposed to revise and expand the RCRA Toxicity Characteristic.

1.2 AGENCY ACTIONS IN RESPONSE TO STATUTORY PROVISIONS

The previous section presented a general description of the Congressional mandate instructing the Agency to develop characteristics for identification of hazardous wastes. This section provides a more detailed explanation of the actions taken by the Agency to fulfill this mandate. Specifically, this section outlines the development of the existing EPTC and the proposal to revise and expand the TC. The final TC rule is discussed in Section 1.3.

1.2.1 Extraction Procedure Toxicity Characteristic

On May 19, 1980, the Agency promulgated the EPTC. The EPTC, devised by the Agency in response to the aforementioned RCRA directives, was designed to identify wastes as hazardous based on the characteristic of toxicity. In practical terms, EP toxicity is a measure of the possibility that specific constituents could migrate from a waste to a point of exposure and pose a risk to human health. The methodology for evaluating this characteristic of toxicity involves comparing Regulatory Levels (maximum concentrations) for constituents in a leachate with the concentrations of constituents liberated from a waste during the leaching test. If the concentration of a constituent in the leachate equals or exceeds the RL for a constituent, the waste is deemed hazardous based on the characteristic of toxicity. In choosing an extraction procedure and setting RLs, the Agency developed a specific "mismanagement" scenario, because RCRA mandates that the Agency identify hazardous wastes as those wastes that pose a threat to human health and the environment when improperly managed (RCRA section 1004(5)). The EP was based on a mismanagement scenario that assumes wastes would be co-disposed with municipal wastes in an unlined landfill.

Regulatory Levels in the EPTC

The Agency set Regulatory Levels in the EPTC based upon assumptions regarding the fate and transport of constituents of concern in the environment and information regarding the toxicity of each specific constituent. The first step for developing an RL was to determine a health-based exposure threshold for each constituent. For the EP constituents, the Agency used available National Interim Primary Drinking Water Standards as the health-based thresholds.

The Agency then needed to account for the reduction in constituent concentration that occurs as constituents in leachate travel downward into ground water and laterally within an aquifer. The Agency estimated a dilution and attenuation factor (DAF) to represent the degree to which constituent concentrations would be diminished in the environment. For the EPTC, the Agency estimated that concentrations for all constituents would be reduced by a factor of 100 from the time the leachate was produced in a landfill to the time the constituents reached a drinking water source. A constituent concentration in the original leachate more than 100 times greater than the health-based level at the exposure point would therefore pose a risk to human health. Using a back calculation, the

Regulatory Levels for specific EPTC constituents were determined by multiplying the Drinking Water Standards for each constituent by the estimated DAF of 100.

Extraction Procedure (EP)

In order to evaluate whether or not a waste leachate would exceed the Regulatory Levels for any constituents, a leaching test was also necessary. As described previously, the EP test is a procedure in which a solid waste is exposed to a liquid leaching medium so that constituents are liberated from the waste into the liquid. For liquid wastes, the waste is filtered and the filtrate is considered the leachate. The EP leaching medium for the solid waste leaching test is an acetic acid solution designed to represent the likely leaching medium occurring in the mismanagement scenario (i.e., co-disposal with municipal waste). After the waste is exposed to the acetic acid, the liquid leachate is analyzed to determine the concentration of constituents in the leachate. The results of this test, when compared to the Regulatory Levels for each constituent, serve as the basic criterion for establishing the characteristic of EP toxicity.

Need for Improvement in the EPTC

The Agency recognized several shortcomings of the EPTC that could be improved. First, the EP was not designed to reflect accurately the leaching potential of many constituents of concern; for example, the EP did not model accurately the leachability of organic chemicals. Second, the generic DAF in the EPTC was not scientifically supported. Finally, since there were no widely-accepted health-based thresholds for many chemicals, the number of constituents which could be regulated under the EPTC was limited. Because of these limitations and the directive from Congress in HSWA, the Agency proposed a revised and expanded TC.

1.2.2 The June 13, 1986 Toxicity Characteristic Proposal

EPA proposed the revised and expanded Toxicity Characteristic Rule (TC Rule) on June 13, 1986 (51 FR 21648). The proposed rule responds to HSWA by establishing a new characteristic for hazardous wastes (the TC) that is designed to improve upon and replace the EPTC. The proposed TC included several changes to both the Regulatory Level calculation process and the procedure used in the EP leaching test, and proposed adding 38 more constituents to the list of regulated toxicants.

Regulatory Levels - Chronic Toxicity Reference Levels

The proposed TC introduced new health-based levels, termed Chronic Toxicity Reference Levels (CTRLs), for additional constituents. The CTRLs for 38 proposed new TC constituents were, when available, the Drinking Water Standards (DWSs) or Maximum Contaminant Levels (MCLs) that had been developed since the publication of the EP. In cases where MCLs or DWSs were not available for a particular non-carcinogenic constituent of concern, the proposed TC used the Reference Dose (RfD) for that constituent as the CTRL. The Reference Dose (RfD) is an estimate of the daily dose of a substance which will result in no adverse effect even after a lifetime of exposure.

For carcinogens having no MCL or DWS, the Agency used Risk-Specific Doses (RSD) as the CTRLs. An RSD is the daily intake of a substance that corresponds to a specified excess cancer risk over a lifetime of exposure. The likelihood of cancer defines the risk level, and the RSD is then based on this risk level. For example, if one cancer case in one million (10^{-6} risk) was chosen as a risk level, then the RSD would be that dose of a constituent that would statistically result in one additional cancer case in one million individuals exposed. In the proposed TC, the Agency varied the risk levels for different carcinogens based on the scientific evidence that the constituent causes cancer in humans. A Class A carcinogen was considered a definite human carcinogen and therefore for the purpose of the TC was assigned a higher risk level than a class C carcinogen, which was only a possible human carcinogen. The risk levels for the proposed TC constituents were 10^{-5} for Class A and B carcinogens and 10^{-4} for Class C carcinogens.

One aspect of the proposed TC that affected the CTRLs for constituents was apportionment. For non-carcinogens that used RfDs in the calculation of Regulatory Levels, the proposed TC accounted for possible alternative routes of exposure. In the proposal, the Agency apportioned RfDs among exposure routes based on available information about the presence of constituents in other potential sources of exposure (e.g., food and air). If no information was available on alternative sources, the Agency used a 50 percent apportionment factor for the RfD. Apportionment effectively reduced the allowable dose of a constituent in drinking water to account for the existence of other exposure sources.

For carcinogens, the proposed TC did not account for apportionment because of the uncertainty involved in the calculation of RSDs. The RSD calculation process was conservative by design, so that a difference in the daily dose to account for apportionment would still be well within the margin of uncertainty of the estimated RSD. In addition, since carcinogenic risk is determined by the daily dose averaged over a lifetime, small variations around the daily dose have little effect on overall risk.

Regulatory Levels - DAFs

The proposed TC also introduced new DAFs for regulated constituents. To determine Regulatory Levels (RLs) for the 44 organic constituents the proposed TC used constituent-specific DAFs based on a ground-water transport model. A Monte Carlo simulation was used to estimate a range of expected DAF values for a variety of environmental and hydrogeologic variables known to influence dilution and attenuation. The ground-water transport model then calculated a cumulative frequency distribution of DAFs generated by the Monte Carlo simulation for each constituent, using different combinations of environmental and hydrogeologic variables.

The cumulative frequency distribution allowed the Agency to choose DAFs for each constituent based on the probability that a DAF calculated by the ground-water transport model (based on the randomly chosen conditions) would not exceed the chosen DAF. The Agency used the 85th percentile cumulative frequency interval in the proposed TC. Thus, the constituent-specific DAFs used in the proposal would be expected to exceed the range of DAFs (as calculated by the model) 85 percent of the time. Conversely, only 15 percent of the model-calculated DAFs would be smaller than the chosen DAF. The Agency chose the 85th cumulative percentile DAFs because it believed this to be a reasonably conservative value.

After the DAFs were chosen, the TC Regulatory Levels for each constituent were calculated the same way as in the EP. The Chronic Toxicity Reference Level was multiplied by the DAF for each constituent, resulting in a constituent concentration that could not be exceeded in the leachate without posing a threat to human health. The Regulatory Level was set equal to this calculated value unless current technology did not allow adequate quantitation of the constituent of concern at this level. In such a case, the Quantitation Limit (QL) became the Regulatory Level for the constituent.

Toxicity Characteristic Leaching Procedure (TCLP)

The proposed TC introduced a second generation leaching procedure (the TCLP), which is designed to more accurately depict the leaching of constituents that occurs when a waste is co-disposed with municipal wastes in a landfill . The TCLP contains several technical modifications to the EP test (e.g., revised analytical methods and zero headspace extraction for volatiles) that enable the TCLP to determine the leachability of many organic constituents that could not be addressed accurately by the EP.

After proposing the TC, the Agency published several other follow-up notices of proposed rulemaking containing possible modifications to the TC. The following sections discuss two of these notices.

1.2.3 Supplemental Notice – Wastewaters

The Agency received numerous comments from industry concerning the application of the TC to wastewaters. The commenters were concerned primarily with the application of the TC mismanagement scenario (co-disposal of wastes with municipal wastes in an unlined landfill) to wastewaters managed in surface impoundments. They argued these wastes were virtually never co-disposed with municipal wastes. The commenters recommended that the Agency consider an alternative mismanagement scenario for wastewaters that more accurately reflected the likely mismanagement of these wastes.

On May 18, 1987, EPA published a Supplemental Notice of Proposed Rulemaking in response to these concerns (52 Federal Register 18583). The supplemental notice outlined several possible alternatives for the application of the TC to wastewaters. In the notice, the Agency suggested the possibility of developing a separate mismanagement scenario for wastewaters and presented a series of options for determining whether or not specific wastes would be eligible for testing under the new scenario. The alternative scenario for wastewaters assumed that eligible wastes are managed in an unlined impoundment instead of being co-disposed in a municipal landfill. With this additional mismanagement scenario there would be two separate regulatory levels for each constituent; one regulatory level would be calculated based on the co-disposal assumption, and the other would be determined using the impoundment scenario.

The Agency analyzed data to determine if such a separate scenario was appropriate for wastes managed in impoundments. EPA modified the existing fate and transport model to estimate the dilution and attenuation likely to occur as wastewaters managed in impoundments infiltrated into ground water. After exhaustive review of applicable data, the Agency concluded that, while the mechanics of impoundment waste infiltration and leachate dilution and attenuation are different from those for a landfill, the resulting concentrations of constituents in ground water would not vary significantly from those predicted using the landfill scenario. The presence of lower concentrations of constituents in wastewater and the absence of an acetic acid leaching medium seem to be offset by the increased infiltration of wastewater constituents due to the pressure of hydraulic head in an impoundment. The Agency therefore concluded that ground-water transport of leachate from wastes managed in impoundments is adequately represented by the DAFs developed using the original proposed TC mismanagement scenario.

1.2.4 Notice of Data Availability and Request for Comments on Use of Generic DAFs

Due to the uncertainties and delays involved with developing sufficiently representative DAFs for each specific TC constituent, the Agency published a Notice of Data Availability and Request for Comments on May 19, 1988. In this notice, the Agency proposed an alternative to the constituent-specific DAFs in the proposed TC. The Agency presented a two-tiered approach to developing DAFs for the TC. In the first tier, the Agency would use generic DAFs for all 38 new TC constituents while development of constituent-specific DAFs proceeded. Once the development of these DAFs was completed, they would be implemented in the second tier. The Agency specifically requested comment on the use of a relatively high, generic DAF that would initially result in regulation of the most toxic wastes. Once constituent-specific DAFs were determined, lower regulatory levels would result in more waste exhibiting the TC. Since EPA was able to resolve issues surrounding the fate and transport model for the constituents to be included in the final rule, the Agency decided to use the model to develop DAFs.

1.3 REGULATORY OPTIONS AND FINAL RULE

As previously mentioned, the Agency considered numerous regulatory options for the TC, including the four major regulatory options defined below. The approach for determining DAFs varied in many of these options, as did risk levels used to select the RSDs for carcinogens, and the number of constituents subject to evaluation. For example, the Agency developed a series of options in which various generic DAFs were used, two different sets of constituents were included (the proposed constituents and a second list of additional constituents), and the risk levels for carcinogens were varied. Other series of options included holding the carcinogen risk levels and constituents constant and varying the value of the cumulative frequency of DAF from the ground-water transport model.

This RIA examines four regulatory options:

- DAF 33,
- DAF 100,
- DAF 250, and
- DAF 500.

The following factors are held constant across all regulatory options examined in this RIA:

- The list of additional regulated constituents comprises 25 organic constituents (listed in Exhibit 1-1);
- RSDs are set at 10^{-5} risk level;

EXHIBIT 1-1

CONSTITUENTS REGULATED UNDER THE FOUR REGULATORY OPTIONS AND CORRESPONDING CTRLS[1]

Regulated Constituent	CTRL (mg/l)[2]
benzene	.005
carbon tetrachloride	.005
chlordane	.0003
chlorobenzene	1
chloroform	.06
1,4-dichlorobenzene	.075
1,2-dichloroethane	.005
1,1-dichloroethylene	.007
2,4-dinitrotoluene	.0005
heptachlor	.00008
hexachloro-1,3-butadiene	.005
hexachlorobenzene	.0002
hexachloroethane	.03
m-cresol	2
methyl ethyl ketone	2
nitrobenzene	.02
o-cresol	2
p-cresol	2
pentachlorophenol	1
pyridine	.04
tetrachloroethylene	.007
trichloroethylene	.005
2,4,5-trichlorophenol	4
2,4,6-trichlorophenol	.02
vinyl chloride	.002

---

[1] Regulatory levels for the 14 existing EPTC constituents were assumed to stay the same. Thus, only the 25 organic constituents to be added were analyzed.

[2] Regulatory Level = CTRL x DAF.

- Quantitation Limits supercede calculated Regulatory Levels if the Quantitation Limits are higher; and

- CTRLs are not apportioned among other sources of exposure.

The general equation for constituent regulatory levels for a regulatory option is RL = (CTRL) X DAF. Therefore, for carcinogens, the RLs for the four options are the MCLs or DWSs (if either is established), or the RSD at 10^{-5}, multiplied by the appropriate DAFs. For non-carcinogens, the RLs are the MCLs or DWSs (again, if either is established), or the RfD, multiplied by the DAFs. Exhibit 1-1 lists the constituents included in the analysis of these options and their corresponding CTRLs.

The regulatory option selected for the final TC rule is the DAF 100 option examined in this RIA. Twenty-five additional organic constituents will be regulated, with the RL for each constituent equal to the CTRL for that constituent multiplied by 100. CRTLs are, where available, DWSs or MCLs. Where no DWSs or MCLs are available, CTRLs are RFDs for non-carcinogens. CRTLs are not apportioned to account for possible alternative routes of exposure. Regulatory levels for the existing EP constituents are not changing with the final TC rule. The final TC replaces the EP with the TCLP as the specified test method for the Toxicity Characteristic.

1.4 REGULATORY ANALYSIS REQUIREMENTS

1.4.1 "Major Rule" Requirement

Executive Order 12291 requires EPA to conduct a complete RIA for all rules that meet the definition of a "major rule." A major rule is one likely to result in (1) an annual impact on the economy of $100 million or more, (2) a major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions, or (3) significant adverse impacts on competition, unemployment, investment, productivity, innovation, or the ability of United States-based enterprises to compete in domestic or export markets. The RIA requirement was designed so that Agencies would conduct detailed assessments of the costs and benefits of any rule that would have a significant impact on the regulated community. This detailed assessment would serve as an aid in assessing tradeoffs among regulatory options.

Preliminary analysis by the Agency indicated that the final TC Rule was a major rule. Thus, in fulfillment of the Executive Order, the Agency prepared this RIA to compare the costs and benefits of the regulatory options outlined above.

1.4.2 Regulatory Flexibility Act

The Regulatory Flexibility Act requires the Agency to assess the impacts of its actions on small entities. The Act requires the Agency to publish for comment an assessment of the impacts on small entities in the regulated community unless the Administrator certifies that the rule will not have a significant impact on a substantial number of small entities. The analysis of impacts on small entities is discussed in Chapter 4.

1.5 ORGANIZATION OF THE RIA

Chapters 2 through 5 present a detailed description of the methodologies and results of the RIA for the four major regulatory options. Chapter 2 describes how wastes and facilities were characterized. Chapter 3 presents estimates of the costs faced by generators and handlers of TC wastes. Chapter 4 summarizes how these costs of the regulatory options translate into impacts on the universe of affected facilities. Chapter 5 describes the models used to estimate the benefits of the regulatory options and the results of the benefits analysis.

Chapter 2 explains the characterization of affected wastes and facilities that served as a basis for estimating costs, economic impacts. and benefits of the TC rule. The chapter begins by describing the data that the Agency used to identify industries generating wastes with the potential to exhibit the TC and to characterize these wastes. Next, the methodology for estimating quantities of wastes that will be newly hazardous under the TC is presented. The assumptions and calculations used to estimate numbers of facilities and patterns of waste generation at these facilities follow. Results are presented in each of the sections on affected wastes and affected facilities, after methodologies and assumptions are explained. Next, limitations of the characterization of affected wastes and facilities are discussed. The section addressing limitations also discusses sensitivity analyses conducted. The last section of this chapter discusses estimates of the potential ranges of affected wastes and facilities. The methodology for characterizing wastes and affected facilities is summarized graphically in Exhibit 2-1.

2.1 WASTE CHARACTERIZATION

Characterization of the existing potentially affected universe (i.e., the pre-regulatory or baseline scenario) for this analysis consisted of three main elements: identifying industries to be examined, accumulating information on the wastes generated by these industries, and identifying current management practices for the wastes.

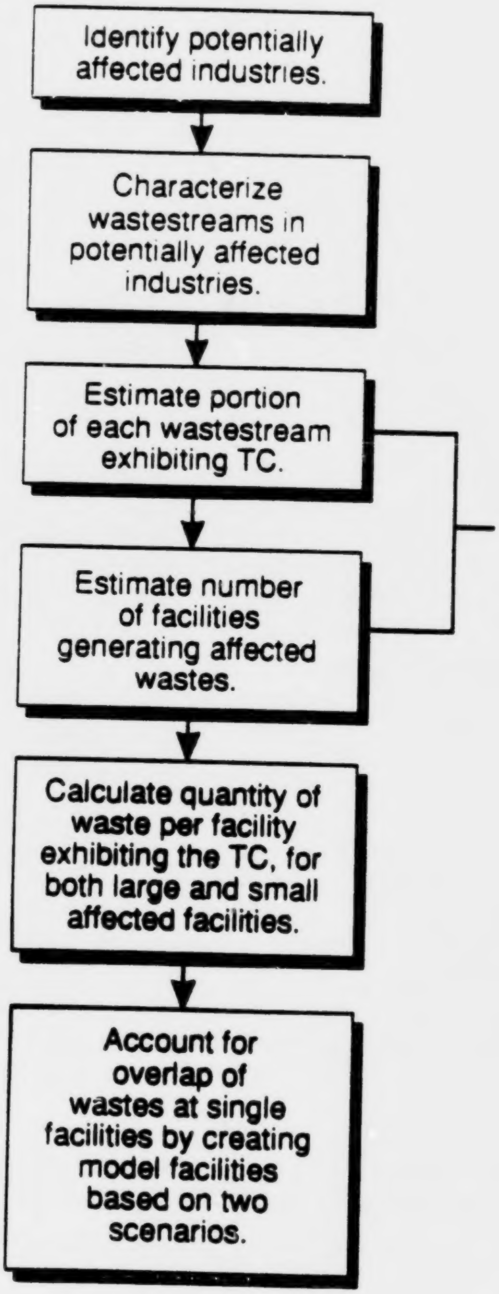
2.1.1 Industries Examined and Sources of Information

Under EPA direction, a series of industry studies was prepared for use in the TC RIA. The preliminary studies examined a large number of industries, with emphasis on identifying whether or not TC constituents would be likely to be present in industry wastes. Based on the preliminary studies, EPA completed detailed profiles for 15 major industrial sectors. These 15 sectors were identified as the industries most likely to generate large quantities of waste potentially affected by the TC. Exhibit 2-2 lists the industrial sectors for which detailed profiles were completed. Report titles for these detailed profiles are listed in the References section.

This RIA presents estimates of the costs, economic impacts, and benefits attributable to the TC for all industrial sectors for which detailed profiles were completed except three. Data in the industry profile for Printing and Publishing indicated that wastes generated by the industry did not contain TC constituents above regulatory levels under consideration. Thus, the Printing and Publishing sector was dropped from the analysis because data indicated that the industry would not experience significant TC impacts. Large volume wastestreams in the Electrical Services industry were not included in the analysis because they are currently exempt from Subtitle C regulation. Fossil fuel combustion wastes were exempted from RCRA Subtitle C pending completion of a Report to Congress on these wastes and a regulatory determination as to whether to regulate these wastes under Subtitle C of RCRA. There was insufficient information for detailed quantitative analysis for the third sector, Machinery and Mechanical Products. Also, the limited information that was

Exhibit 2-1

Characterizing Wastes and Affected Facilities


Identify potentially affected industries.
Characterize wastestreams in potentially affected industries.
Estimate portion of each wastestream exhibiting TC.
Estimate number of facilities generating affected wastes.
Calculate quantity of waste per facility exhibiting the TC, for both large and small affected facilities.
Account for overlap of wastes at single facilities by creating model facilities based on two scenarios.

Percentage exhibiting TC is applied to both wastestream quantity and the number of facilities generating the wastestream. This yields affected waste quantity and affected number of facilities.

EXHIBIT 2-2

EPA INDUSTRY PROFILES COMPLETED FOR USE IN TC ANALYSIS

Industry	Standard Industrial Classification a/
Textile Mills*	22
Lumber and Wood Products*	2421, 2499
Pulp and Paper*	261, 262, 263, 266
Printing and Publishing	27
Plastics Materials and Resins*	2821
Synthetic Rubber*	2822
Synthetic Fibers*	2823,2824
Pharmaceuticals*	283
Organic Chemicals*	2865, 2869
Petroleum Refining*	2911
Rubber and Miscellaneous Plastics Products*	30
Machinery and Mechanical Products	34 through 39
Pipelines, except Natural Gas*	461
Electrical Services	4911
Wholesale Petroleum Marketing*	517

---

a/ SICs listed are those defining the group considered in this analysis. SICs given at the two-digit or three-digit SIC level indicate that the analysis applies to all four-digit SICs contained within the broader category.

* Included in detailed quantitative analysis for the RIA. SIC 2992 (Miscellaneous Petroleum and Coal Products) was also included in detailed analysis for the RIA, using data from Composition and Management of Used Oil Generated in the United States.

available for Machinery and Mechanical Products indicated that wastestreams containing TC constituents also contain high levels of metals and, thus, may already be hazardous under the existing Extraction Procedure Toxicity Characteristic (EPTC).

For the industry profiles, information was available for different industries at different SIC levels (two-digit, three-digit, or four-digit). Data were used in the analysis at the most specific SIC level available. Throughout the rest of this RIA, in tables and text, industries may be referred to by either name or SIC. Exhibit 2-3 lists all SICs and corresponding industry names used in the RIA, for reference when necessary.

In addition to relying on wastestream characterization data in the industrial profiles for 12 major industrial sectors, EPA considered the possibility that one wastestream that occurs in many industries -- used oil -- might exhibit the TC. The Agency extracted data from its 1984 report Composition and Management of Used Oil Generated in the United States to analyze used oil and the used oil collection and distribution industry. (Used oil collectors and distributors are included in SIC 2992.)

2.1.2 Types of Wastestreams Included and Characterization Data

The majority of wastestreams examined for this analysis are wastewaters and associated wastewater treatment sludges. Virtually all of these wastewaters, according to available information, are discharged, after treatment in wastewater treatment systems, to surface waters under National Pollutant Discharge Elimination System (NPDES) permits or to Publicly Owned Treatments Works (POTWs). Sludges originate in wastewater treatment units, mainly tanks and surface impoundments. Treatment processes that occur in these units include sedimentation, coagulation and flocculation, flotation, activated sludge treatment, and aeration. As a wastewater stream passes through different steps in a treatment train, different sludges are formed depending on the treatment taking place. In addition to analyzing wastewaters and wastewater treatment sludges, EPA also analyzed some solid process residuals and organic liquids.

The following wastestream characterization data elements were used in the analysis

- Waste type as either aqueous liquid, sludge/slurry, solid residual, or organic liquid;
- Total quantity of waste generated in metric tons per year (MT/yr);
- Maximum and minimum concentration for each TC constituent present in the wastestream;
- Estimated concentration distribution (normal, lognormal, or uniform) between the maximum and minimum concentrations; and
- Number of facilities generating each wastestream.

It was in some cases necessary to use best engineering judgement to fill in data gaps. In particular, best engineering judgement was used to classify wastes into waste types and to assume concentration distributions for some wastestreams.

EXHIBIT 2-3

STANDARD INDUSTRIAL CLASSIFICATIONS (SICs) AND CORRESPONDING INDUSTRY NAMES

SIC [a]	Industry
2231	Wool Dyeing and Finishing
225X	Hosiery and Knit Fabric Finishing
226X	Woven Fabric Finishing
227X	Carpet Finishing
2299	Wool Scouring
229X	Miscellaneous Textile Manufacturing
22XX	Low Water Use Processing Mills
22YY	Stock and Yarn Processing, Dyeing, and Finishing
2421	Sawmill and Planing Mill and Finishing
2499	Wood Products, Not Elsewhere Classified
26XX	Pulp and Paper Mills
2821	Plastics Materials and Resins
2822	Synthetic Rubber
2823	Synthetic Fibers, Cellulosic
2824	Synthetic Fibers, Non-Cellulosic
283X	Pharmaceuticals
286X	Organic Chemicals
2911	Petroleum Refining
2992	Miscellaneous Petroleum and Coal Products
3011	Tires and Inner Tubes
3021	Rubber and Plastics Footwear
3031	Reclaimed Rubber
3041	Rubber and Plastics Hose and Belting
3069	Fabricated Rubber Products, Not Elsewhere Classified
3079	Miscellaneous Plastics Products
461	Petroleum Pipelines
517	Wholesale Petroleum Marketing

---

[a] Letters (X or Y) indicate that the grouping does not include all four-digit SICs within the two-digit or three-digit SIC.

2.1.3 Baseline Management Practices

The Agency used information from its Screening Survey of Industrial Subtitle D Establishments to characterize baseline (i.e., pre-TC) management practices for wastes under consideration for this analysis. EPA did not have facility-specific information in its industry profiles, but rather had characterization of aggregate wastestreams, each generated by a number of individual facilities. The Agency estimated baseline management practices for wastestreams via several steps. EPA first identified likely baseline management practices for each of the four types of wastes included in the analysis: wastewaters, sludge/slurries, solid residuals, and organic liquids. The Agency then looked to the Screening Survey for industry-specific and facility size-specific information about the use of the likely management practices. (Small and large facilities were defined by a 50 employee cutoff.) The Screening Survey provided industry-specific percentages of facilities using each management practice for Subtitle D wastes; EPA applied these percentages to the facilities generating potential TC wastes in order to assign baseline management practices.

Since virtually all wastewaters in this analysis are discharged to surface waters under NPDES permits or to POTWs after treatment in wastewater treatment systems, it was necessary to identify management units used in the wastewater treatment systems in order to characterize the baseline. The Agency used information from the Screening Survey to estimate the number of facilities (large and small) in each industry that manage wastewaters in surface impoundments, since wastes managed in these units would potentially be affected by the TC. Other facilities were assumed to be using baseline management practices already compliant with Subtitle C; thus these facilities would not have to change management practices and would not incur incremental waste management costs as a result of the TC rule. The most notable management practice for wastewaters that would not require change after promulgation of the TC is treatment in tanks prior to discharge regulated under the Clean Water Act. These tanks are exempt from Subtitle C permitting requirements (40 CFR 264.1 (g)(6)). Further, since wastewaters managed in exempt tanks are not considered to be regulated under a "substantive" requirement, they need not be counted toward generator quantity thresholds. Thus, facilities using exempt tanks are not subject to generator requirements if there are no other regulated units (e.g., down-line surface impoundments) or regulated activities (e.g., storage) in the treatment train. Other baseline wastewater management practices which could continue under Subtitle C include direct discharge without treatment (compliant with an NPDES permit) and recycling.

EPA identified three likely baseline management practices for sludge/slurry wastestreams: on-site landfilling, off-site landfilling, and on-site land treatment for those wastes suitable for land treatment. The Screening Survey contained industry-specific percentages of facilities (large and small) managing wastes on-site in landfills and by land application. These percentages were applied to facilities generating potential TC wastes in order to assign baseline management practices. Land application percentages were applied only for those facilities generating wastes that are physically and chemically suitable for land treatment. The percentage of facilities using on-site landfills or land treatment was less than 100 percent for all industries. For the percentage not using on-site landfills or land treatment, EPA assumed off-site landfilling as the baseline practice.

For solid residuals, EPA divided facilities generating the wastes into two baseline management practice groups. Screening Survey data provided percentages of facilities using on-site landfills; the Agency assumed the other facilities send waste to off-site sanitary landfills.

Using data from the Office of Solid Waste Industry Studies Data Base (ISDB), the Agency identified three predominant baseline management practices for organic liquids: management in tanks followed by discharge under the Clean Water Act, reuse or recovery, and incineration or burning in boilers. In most cases, these management practices could continue under Subtitle C without substantial additional cost. Therefore, these wastes were not included in subsequent analysis.

2.1.4 Used Oil

EPA addressed the impacts of the TC on used oil separately from other wastes for several reasons. First, used oil is generated across a wide variety of industrial sectors. Second, assessing costs associated with used oil management is complicated because, unlike other wastes, it has economic value and can be sold in intermediate or end-use markets. Also, data on used oil are quite limited. Finally, it is difficult to accurately estimate quantities of used oil that may exhibit the TC because actual TCLP results for used oil are sample-specific and more difficult to predict than those for other non-oily wastes.

To assess the impacts of the TC on used oil, EPA first determined the quantity of used oil potentially affected. Data on used oil quantities, characterization, and management practices came primarily from Composition and Management of Used Oil Generated in the United States. Used oil that was already hazardous by characteristic (ignitability or EP toxicity) or that was recycled or burned as fuel was excluded from the analysis, since it would not be affected by the TC.

Test data were not available to determine whether used oil would exhibit the TC. Used oil may not fail the TCLP because of its oily consistency. In order to develop worst-case estimates of quantities of used oil that might exhibit the TC, EPA assumed that used oil would pass through the TCLP filter and the quantity of used oil that will exhibit the TC was estimated by the same method as for other wastes (See Section 2.2.1). Resulting estimates are presented in Section 2.2.3. Detailed discussion of the used oil analysis is included in Appendix A.

2.2 QUANTITIES OF WASTE EXHIBITING THE TC

The Agency estimated, based on constituent concentration data, the quantity of each wastestream characterized for the analysis that would exhibit the TC. Determining what wastes will be brought into the hazardous waste system serves as the starting point for estimates of how many facilities will be affected by the TC rule, what cost these facilities and society will incur, and what benefits will accrue due to TC regulation.

2.2.1 Methodology

To predict the quantity of each wastestream that would exhibit the TC, the Agency first established regulatory level options for constituents under each regulatory option.[1] As proposed in the June 13, 1986 proposed rule, the quantitation limits for constituents were used instead of the calculated regulatory levels wherever the quantitation limit exceeded the calculated regulatory level. Based on these regulatory levels, the Agency identified a critical concentration for each constituent above which the waste would exhibit the TC. For wastewaters and organic liquids, this concentration equaled the regulatory level; for non-liquids, the Organic Leaching Model (OLM) was used to convert the regulatory level to the corresponding waste concentration. The OLM was developed by the Agency to predict the leachate concentrations of organic chemicals. It predicts leachate concentrations from total waste constituent concentrations using a concentration and solubility-based logarithmic equation (51 Federal Register 41084). The equation can be used in reverse to convert a leachate concentration to a corresponding waste concentration; this was done to convert the TC regulatory levels to corresponding waste concentrations.

---

[1] Regulatory options are explained in Chapter 1.

Using a computerized database, EPA compared the concentration range for each constituent in every wastestream with the critical concentration for that constituent. Constituent concentration distributions were either uniform, normal, or lognormal. Based on distribution-specific statistical calculations for each constituent, the Agency determined what portion of the wastestream would exhibit the TC solely by virtue of the presence of that constituent. The constituent that resulted in the largest percentage exhibiting the TC was designated the volume-driving constituent. Multiplying the percentage of the wastestream exhibiting the TC by the total quantity of the wastestream yielded the estimated quantity that exhibits the TC. By using this procedure, EPA assumed direct correlation of constituent concentrations; the highest concentrations of one constituent are present along with the highest concentrations of other constituents in the wastestream. The Agency tested the sensitivity of results to the direct correlation assumption by adding the percentages of waste exhibiting the TC for each constituent, instead of picking a driving constituent. This sensitivity analysis, discussed further in section 2.4, assumed a perfect inverse correlation.

The Agency used the "driving" constituent concept because, in the absence of data from specific facilities or concentration correlation data, this approach offered the best methodology for estimating what wastes would exhibit the TC. It is worth noting that the driving constituent might "mask" the presence of other TC constituents in the wastestreams.

An additional step was required for wastewaters to determine affected quantity. As mentioned in Section 2.1.3, only some portion of facilities in each industry manage their non-hazardous wastewaters in surface impoundments. Other facilities use management practices that would be compliant with RCRA Subtitle C regulations, even if the wastewaters managed were designated hazardous under the TC. EPA multiplied Screening Survey percentages of facilities managing wastes in surface impoundments by the quantities exhibiting the TC to determine the wastewater quantities actually affected by the rule. EPA performed sensitivity analysis on the use of the Screening Survey percentages by alternatively assuming all wastewaters are managed in surface impoundments. This provided an upper bound for the estimated quantity of affected wastewaters (see Section 2.4).

2.2.2 Results

Exhibit 2-4 summarizes quantities of waste that would be affected by the TC for the four regulatory options being considered. Total affected waste quantities range from 660

EXHIBIT 2-4

TOTAL QUANTITIES OF WASTE AFFECTED BY THE TC RULE (MT/YEAR)

Regulatory Option	Wastewater Quantity	Non-Wastewater Quantity
DAF 33	840,000,000	3,100,000
DAF 100	730,000,000	1,800,000
DAF 250	700,000,000	710,000
DAF 500	660,000,000	510,000

million metric tons per year (MMT/yr) at DAF 500 to 840 MMT/yr at DAF 33, an increase of almost 30 percent from the least stringent option to the most stringent option. Between DAF 100 and DAF 250, wastewater quantities affected drop by 30 MMT (about 4 percent). Affected non-wastewaters quantities differ more significantly than affected wastewaters quantities between DAF 250 and 100: affected non-wastewater quantities more than double from 710,000 MT/yr at DAF 250 to 1.8 MMT/yr at DAF 100.

For all four options, wastewaters account for over 99 percent of the total affected waste quantity. It is important to note that, while large quantities of wastewaters may be affected by the TC, these wastewater quantities will not necessarily be brought into the Subtitle C waste management system. This RIA predicts, based on cost analysis, that handlers of wastewaters affected by the TC will choose to switch from management in surface impoundments to management in exempt tanks. Thus, these wastewaters will be affected because a new management practice will be required; however, for practical purposes, they will not constitute new hazardous wastes.

Exhibits 2-5 through 2-8 show quantities of affected waste by industry for each regulatory option. The exhibits also show the estimated split of waste generation between large and small facilities. The assignment of affected waste quantities to generating facilities is discussed in section 2.3. The discussion that follows will focus first on wastewaters and then on non-wastewaters. Discussion of total waste quantity would correspond to that for wastewaters since wastewaters constitute over 99 percent of affected waste volume.

The Petroleum Refining Industry generates the largest affected wastewater quantity under all options. Wastewater from the Petroleum Refining industry constitutes over 60 percent of the total affected wastewater quantity for the DAF 33 option and about 70 percent of the total affected wastewater quantity for the other three options. The Petroleum Refining wastewater quantity affected is about 500 MMT/yr for all options (dropping to 470 MMT/yr at DAF 500). The driving constituent for Petroleum Refining wastewater is benzene. Concentration data used in the TC RIA database corresponded to the point in the treatment train after API separation and/or DAF flotation.

The Pulp and Paper industry generates the second largest quantity of affected wastewaters (75 MMT/yr, about 10 percent of total) under the DAF 33 option. Under this most stringent option, TC wastewaters are predicted to be generated by four sectors of the industry: papergrade sulfite, de-inking, bleached kraft, and alkaline fine. However, affected Pulp and Paper wastewater quantities drop to 3.5 MMT/yr at DAF 100 and to zero by DAF 250. Chloroform and trichloroethylene are driving constituents in Pulp and Paper wastewaters.

Two industries, Organic Chemicals and Synthetic Fibers, each generate about 10 percent of affected wastewaters under all regulatory options. Organic Chemicals generates the second largest quantity of affected wastewaters (62 MMT/yr) under the DAF 100 option and Synthetic Fibers generates the second largest affected wastewater quantity (61 MMT/yr) under the DAF 250 option. Driving constituents in Organic Chemicals wastewaters include benzene, chloroform, carbon tetrachloride, vinyl chloride, methyl ethyl ketone, and 2,4-dinitrotoluene. Driving constituents in Synthetic Fibers wastewaters are benzene for the cellulosic sector and vinyl chloride for the non-cellulosic sector. Other industries that

EXHIBIT 2-5

QUANTITIES HANDLED BY INDUSTRIES INCURRING COSTS (DAF 33)

SIC**	AFFECTED WASTEWATER QUANTITY (MT/YR)			AFFECTED NON-WASTEWATER QUANTITY (MT/YR)		
	LARGE	SMALL	TOTAL*	LARGE	SMALL	TOTAL*
2231	630,000	24,000	650,000	390	0	390
225X	21,000,000	380,000	21,000,000	27,000	3,900	31,000
226X	1,700,000	45,000	1,700,000	48,000	2,900	51,000
229X	140,000	12,000	150,000	0	0	0
22YY	5,000,000	33,000	5,000,000	530	0	530
2421	1,300	240	1,500	0	0	0
26XX	75,000,000	120,000	75,000,000	630,000	4,600	630,000
2821	26,000,000	680,000	27,000,000	28,000	2,900	31,000
2822	35,000,000	1,800,000	37,000,000	91,000	7,800	99,000
2823	34,000,000	0	34,000,000	130,000	0	130,000
2824	27,000,000	67,000	27,000,000	12,000	34	12,000
283X	31,000,000	660,000	32,000,000	93,000	5,000	98,000
286	72,000,000	2,200,000	74,000,000	140,000	7,100	150,000
2911	500,000,000	0	500,000,000	1,600,000	0	1,600,000
2992	0	0	0	23,000	23,000	46,000
3031	0	0	0	30	0	30
461	900,000	190,000	1,100,000	12,000	6,300	18,000
517	2,800,000	4,600,000	7,400,000	32,000	140,000	170,000
TOTALS*	830,000,000	11,000,000	840,000,000	2,900,000	200,000	3,100,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 2-6

QUANTITIES HANDLED BY INDUSTRIES INCURRING COST (DAF 100)						
SIC**	AFFECTED WASTEWATER QUANTITY (MT/YR)			AFFECTED NON-WASTEWATER QUANTITY (MT/YR)		
	LARGE	SMALL	TOTAL*	LARGE	SMALL	TOTAL*
2231	0	0	0	210	0	210
225X	8,100,000	140,000	8,200,000	9,100	1,300	10,000
226X	1,900,000	45,000	1,900,000	32,000	2,000	34,000
2421	1,300	240	1,500	0	0	0
26XX	3,300,000	210,000	3,500,000	300,000	2,100	300,000
2821	21,000,000	680,000	22,000,000	27,000	2,800	30,000
2822	34,000,000	1,700,000	36,000,000	91,000	6,600	98,000
2823	34,000,000	0	34,000,000	130,000	0	130,000
2824	27,000,000	67,000	27,000,000	12,000	34	12,000
283X	26,000,000	550,000	27,000,000	77,000	4,100	81,000
286	60,000,000	1,800,000	62,000,000	110,000	5,800	120,000
2911	500,000,000	0	500,000,000	800,000	0	800,000
2992	0	0	0	15,000	15,000	30,000
461	900,000	190,000	1,100,000	11,000	5,300	16,000
517	2,800,000	4,600,000	7,400,000	27,000	110,000	140,000
TOTALS*	720,000,000	10,000,000	730,000,000	1,600,000	160,000	1,800,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 2-7

QUANTITIES HANDLED BY INDUSTRIES INCURRING COSTS (DAF 250)

SIC**	AFFECTED WASTEWATER QUANTITY (MT/YR)			AFFECTED NON-WASTEWATER QUANTITY (MT/YR)		
	LARGE	SMALL	TOTAL*	LARGE	SMALL	TOTAL*
2231	0	0	0	44	0	44
226X	1,300,000	41,000	1,300,000	13,000	810	14,000
2421	1,300	240	1,500	0	0	0
26XX	0	0	0	17,000	120	17,000
2821	14,000,000	470,000	14,000,000	16,000	1,600	18,000
2822	35,000,000	1,700,000	37,000,000	91,000	6,600	98,000
2823	34,000,000	0	34,000,000	130,000	0	130,000
2824	27,000,000	67,000	27,000,000	12,000	34	12,000
283X	26,000,000	550,000	27,000,000	59,000	3,100	62,000
286	53,000,000	1,500,000	55,000,000	100,000	5,100	110,000
2911	500,000,000	0	500,000,000	70,000	0	70,000
2992	0	0	0	7,900	8,000	16,000
461	900,000	190,000	1,100,000	10,000	5,100	15,000
517	2,800,000	4,600,000	7,400,000	26,000	110,000	140,000
TOTALS*	690,000,000	9,100,000	700,000,000	550,000	140,000	700,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 2-8

QUANTITIES HANDLED BY INDUSTRIES INCURRING COSTS (DAF 500)

SIC**	AFFECTED WASTEWATER QUANTITY (MT/YR)			AFFECTED NON-WASTEWATER QUANTITY (MT/YR)		
	LARGE	SMALL	TOTAL*	LARGE	SMALL	TOTAL*
226X	0	34,000	34,000	0	0	0
2421	1,300	230	1,500	0	0	0
26XX	0	0	0	3,100	22	3,100
2821	13,000,000	350,000	13,000,000	12,000	1,300	13,000
2822	33,000,000	1,600,000	35,000,000	90,000	6,600	97,000
2823	33,000,000	0	33,000,000	130,000	0	130,000
2824	27,000,000	66,000	27,000,000	11,000	34	11,000
283X	23,000,000	480,000	23,000,000	56,000	2,900	59,000
286	52,000,000	1,400,000	54,000,000	77,000	3,900	81,000
2911	470,000,000	0	470,000,000	30,000	0	30,000
2992	0	0	0	5,700	5,900	12,000
461	890,000	190,000	1,100,000	4,600	2,200	6,800
517	2,800,000	4,600,000	7,400,000	12,000	50,000	62,000
TOTALS*	650,000,000	8,800,000	660,000,000	440,000	73,000	510,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

generate significant quantities of wastewater under the DAF 100 and DAF 250 options are Synthetic Rubber, Plastics and Resins, and Pharmaceuticals.

Petroleum Refining generates the largest quantity of affected non-wastewaters under the DAF 33 option (1.6 MMT/yr, about 50 percent of total) and DAF 100 option (800,000 MT/yr, about 40 percent of total). Petroleum Refining affected non-wastewaters drop to 70,000 MT/yr at DAF 250 (about 10 percent of total) and to 30,000 MT/yr at DAF 500 (about 6 percent of total). Petroleum Refining non-wastewater wastestreams that exhibit the TC at DAF 100 include treating clay from extraction/isomerization, treatment clay from clay filtering, crude storage tank sludge, unleaded storage tank sludge, and primary treatment sludges. Primary treatment sludges are the largest quantity affected non-wastewater wastestream of all these; about 700,000 MT/yr exhibit the TC at DAF 100. All of the Petroleum Refining wastestreams mentioned are also affected under the DAF 250 option except treatment clay from clay filtering and unleaded storage tank sludge. The driving constituent for all Petroleum Refining wastestreams is benzene.

The Synthetic Fibers industry generates the largest quantity of affected non-wastewaters at the DAF 250 and DAF 500 options. The affected non-wastewater quantity for this industry is fairly constant across all options at around 140,000 MT/yr. About 130,000 MT/yr of this quantity comprises wastewater treatment sludges generated by the cellulosic sector. The driving constituent for sludges from the cellulosic sector is benzene.

Sludges from the Pulp and Paper industry constitute about 20 percent of affected non-wastewater quantity under the DAF 33 and DAF 100 options. About 630,000 MT/yr of affected wastewater treatment sludges are generated by the Pulp and Paper industry under the DAF 33 option, approximately 300,000 MT/yr under the DAF 100 option, 17,000 MT/yr under the DAF 250 option, and only 3,100 under the DAF 500 option. Chloroform is the driving constituent in sludges from the Pulp and Paper industry.

Other industries that generate significant quantities of affected non-wastewaters under the DAF 100 and 250 options are Wholesale Petroleum Marketing and Organic Chemicals. About 140,000 MT/yr of Wholesale Petroleum Marketing non-wastewaters are affected under both options. The affected wastestreams are crude oil tank cleaning sludge and unleaded gasoline tank cleaning sludge; the driving constituent is benzene. As for Organic Chemicals non-wastewaters, 120,000 MT/yr are affected under the DAF 100 option and 110,000 under the DAF 250 option. Driving constituents in Organic Chemicals non-wastewaters include benzene, vinyl chloride, carbon tetrachloride, methyl ethyl ketone, chloroform, and 2,4-dinitrotoluene.

Exhibits 2-9 and 2-10 present the specific wastestreams that drive the analysis of non-wastewater quantities affected. Non-wastewaters are presented because, as will be discussed in Chapter 3, non-wastewaters drive costs. Exhibit 2-9 shows the five largest-quantity affected non-wastewaters at the most stringent option and the quantities of these wastestreams that exhibit the TC under the other options. As can be seen in the exhibit, all five largest-quantity affected non-wastewaters under the DAF 33 option no longer exhibit the TC under the DAF 500 option. Exhibit 2-10 presents the five largest-quantity affected wastestreams under the DAF 100 option and the quantities of these five wastestreams that exhibit the TC under the DAF 250 and 500 options. The affected quantity of primary treatment sludges from Petroleum Refining decreases significantly from DAF 100 to DAF

EXHIBIT 2-9

DRIVING NON-WASTEWATER WASTESTREAMS FOR DAF 33: QUANTITIES AFFECTED (MT/YR) UNDER OTHER REGULATORY OPTIONS					
REGULATORY OPTION (DAF)	SIC 2911 PRIMARY TREATMENT SLUDGES	SIC 2911 SECONDARY TREATMENT SLUDGES	SIC 26XX SEDIMENTATION/OXIDATION SLUDGE, BLEACHED KRAFT	SIC 26XX SEDIMENTATION/OXIDATION SLUDGE, MISCELLANEOUS INTEGRATED	SIC 26XX SEDIMENTATION/OXIDATION SLUDGE, ALKALINE FINE
33	770,000	690,000	210,000	170,000	140,000
100	720,000	0	180,000	0	100,000
250	1,200	0	0	0	0
500	0	0	0	0	0

EXHIBIT 2-10

DRIVING NON-WASTEWATER WASTESTREAMS FOR DAF 100: QUANTITIES AFFECTED (MT/YR) UNDER OTHER REGULATORY OPTIONS

REGULATORY OPTION (DAF)	SIC 2911 PRIMARY TREATMENT SLUDGES	SIC 26XX SEDIMENTATION/OXIDATION SLUDGE, BLEACHED KRAFT	SIC 26XX SEDIMENTATION/OXIDATION SLUDGE, ALKALINE FINE	SIC 517 CRUDE OIL TANK CLEANING SLUDGE	SIC 2823 SEDIMENTATION SLUDGE, CELLULOSIC MAN-MADE FIBERS
100	720,000	180,000	100,000	76,000	67,000
250	1,200	0	0	71,000	67,000
500	0	0	0	0	67,000

250, and sludges from the Pulp and Paper industry drop out of regulation between DAF 100 and DAF 250.

Thirteen constituents appear as volume-driving constituents for the most stringent regulatory option (DAF 33): benzene, chloroform, tetrachloroethylene, trichloroethylene, methyl ethyl ketone, vinyl chloride, chlorobenzene, nitrobenzene, pentachlorophenol, 2,4-dinitrotoluene, carbon tetrachloride, heptachlor, and 2,4,6-trichlorophenol. All except the last one also appear as volume-driving constituents in the other three regulatory options. Twelve regulated constituents never appear as volume-drivers: chlordane; o-cresol; m-cresol; p-cresol; 1,4-dichlorobenzene; 1,2-dichloroethane; 1,1-dichloroethylene; hexachlorobenzene; hexachlorobutadiene; hexachloroethane; pyridine; and 2,4,5-trichlorophenol. These constituents did not appear as driving constituents because they were either 1) present in levels below regulatory levels or 2) present in wastestreams for which another constituent was the driving constituent. Benzene is the driving constituent for over 60 percent of affected waste under the DAF 100 option. Other volume-driving constituents for the DAF 100 option include chloroform (25 percent), vinyl chloride (17 percent), and trichloroethylene (5 percent).

2.2.3 Used Oil

As discussed above, in order to arrive at an upper bound estimate of used oil exhibiting the TC, EPA assumed that used oil would completely penetrate the filter in the TCLP. It is difficult to accurately predict actual TCLP results for oily wastes. The Agency estimates that three categories of used oil could be affected by the TC: oil used for road oiling, dumped used oil, and used oil disposed of by landfilling or incineration. The potential affected quantities for these three types are 232,000 MT/year, 374,000 MT/year, and 405,000 MT/year, respectively.

2.3 NUMBER OF FACILITIES AFFECTED

2.3.1 Methodology

The number of facilities generating each wastestream examined in the analysis is a subset of the total number of establishments in an industry because some establishments in an industry may not generate the waste. Characterization data provided numbers of facilities generating each wastestream included in this analysis. For the RIA, EPA divided the number of facilities generating each wastestream into large and small facility size categories, using a cutoff of 50 employees to separate large from small facilities. The proportion of large and small facilities within an SIC was determined using 1982 Census of Manufactures data. Facilities generating each wastestream in the database are assumed to be distributed between large and small facilities in proportion to the split between large and small facilities for the SIC as a whole.

The Agency then estimated the total quantity of each wastestream generated by firms in each size category. EPA assumed that within each size category, all facilities generate the same quantity of waste. Next, the Agency assumed that waste generation is proportional to value of shipments. Census of Manufactures data on value of shipments by size category was used to estimate the percentage of the total quantity of waste generated by facilities in each size category.[2] Again, EPA assumed that the percentages for the entire SIC could be applied to the subset of facilities generating wastes in the database. EPA tested the sensitivity of assuming that waste generation by large and small facilities is proportional to value of shipments by alternatively assuming waste quantities were distributed equally between large and small facilities (i.e., 50 percent generated by large facilities and 50 percent generated by small facilities).

To estimate the number of facilities that generate wastes exhibiting the TC, EPA multiplied the number of facilities (in each size category) generating each wastestream by the percentage of the total wastestream quantity that exhibits the TC.[3] The quantity of each wastestream that exhibits the TC was split evenly (within size category) among the resulting number of facilities generating waste that exhibits the TC. EPA examined two alternative sensitivity analysis assumptions for intermediate percentages (i.e., percentages other than 0 or 100) of wastestreams that exhibit the TC.[4] First, EPA assumed that if an intermediate percentage (not 0 percent or 100 percent) of a wastestream exhibited the TC, then 10 percent of facilities generating that wastestream were potentially affected. This tended to concentrate larger quantities of waste at fewer facilities than in the initial analysis. Second, EPA assumed that if an intermediate percentage of a wastestream exhibited the TC, then 90 percent of facilities generating that wastestream were potentially affected. These two alternative assumptions provided an upper and lower bound sensitivity analysis of affected facilities.

One important assumption is implicit in the method for deriving the number of facilities generating waste that exhibits the TC. The Agency assumed that if a facility generates a waste that exhibits the TC, the entire quantity of that facility's waste exhibits the TC. Thus, the total quantity of any given waste which exhibits the TC is distributed to a group of facilities by assuming that all of a facility's waste either exhibits the TC or does not, rather than distributing some portion of each waste exhibiting the TC among all facilities.

Wastestream characterization data includes the number of facilities generating each wastestream examined for this analysis. Within any given industry, single facilities may be generating multiple wastestreams that exhibit the TC. That is, there may be overlap of the facilities that are generating each separate wastestream in an industry. To account for this overlap, EPA developed two scenarios to assign wastes that exhibit the TC to model facilities: one scenario portrays the maximum number of facilities affected and the other the minimum number of facilities affected.

The Agency derived the maximum and minimum scenarios in conjunction with preliminary cost estimates. Preliminary estimates of incremental cost per facility per wastestream were calculated on a wastestream-by-wastestream basis. Next, EPA considered the possibility of multiple wastes being generated by single facilities. It was possible to categorize wastes into groups within each SIC. Each waste group has a distinct number of generating facilities associated with it. Assuming that each of the facilities associated with the waste group could be generating any number of the wastes in the group, EPA developed the maximum and minimum scenarios when calculating preliminary total incremental costs per facility. The maximum scenario assumes that wastes are generated so that the maximum possible number of facilities will incur costs (i.e., individual wastes that exhibit the TC tend to be generated by different facilities and total per-facility costs tend to be less). The minimum scenario assumes that wastes are generated so that the minimum possible number of facilities incur costs (i.e., individual wastes that exhibit the TC tend to be generated by the same facilities and total per-facility costs tend to be higher). The resulting maximum and minimum scenarios consist of model facilities with different configurations of wastes, consistent with information about linkages between wastes. For example, wastewater treatment sludges were linked to associated wastewaters. Details of the derivation of the maximum and minimum scenarios are presented in Appendix B.

---

[2] For three non-manufacturing SICs (461, 4911, and 517), EPA used number of employees in lieu of value of shipments data.

[3] The derivation of this percentage is described above in Section 2.2.

[4] Clearly, if none or all of a wastestream exhibits the TC, then no facilities or all facilities are affected by the rule because of that wastestream.

The remainder of this section discusses the estimated number of affected facilities for the four regulatory options examined. For this RIA, "affected" is defined to mean incurring additional costs as a result of the final TC rule. Affected facilities are all facilities generating either 1) wastewaters that will exhibit the TC and are currently managed in surface impoundments or 2) non-wastewaters that will exhibit the TC. Note that important categories that may be of interest are subsets of affected facilities as defined in this RIA (e.g., new hazardous waste generators, facilities that already generate hazardous wastes and will generate additional TC hazardous wastes; new treatment, storage, and disposal facilities (TSDFs); and facilities that will convert surface impoundments to exempt treatment tanks.)

2.3.2 Results

Results for the number of facilities affected are presented as ranges in Exhibit 2-11, which represent the maximum and minimum number of affected facilities under the scenarios described above. Exhibit 2-12 summarizes the distribution of TC waste quantities to large and small facilities. The total number of facilities affected for the different regulatory options ranged from about 14,000 (minimum number affected under DAF 500) to 19,000 (maximum number affected under DAF 33). The results are presented, by industry, for each regulatory option in Exhibits 2-13 through 2-16. We highlight results for small facilities and large facilities below.

The number of affected small facilities stays relatively constant across all options at between 13,000 (minimum scenario, DAF 500) and 16,000 (maximum scenario, DAF 33). The number of affected small facilities under the most stringent and least stringent options differs by only about 1,000 facilities (about seven percent) under the maximum facilities affected scenario and by about 2,000 facilities (about 14 percent) under the minimum facilities affected scenario. The small variation, both across options and between the maximum and minimum scenarios, can be explained by examining results for the Wholesale Petroleum Marketing industry. All of the small Wholesale Petroleum Marketing facilities generating wastes (about 13,000) are affected by the TC under all regulatory options. This drives the results for number of small facilities affected. Other industries with significant numbers of small facilities affected at DAF 100 and DAF 250 include Textiles, Miscellaneous Petroleum and Coal Products, and Petroleum Pipelines.

EXHIBIT 2-11

NUMBER OF FACILITIES INCURRING COSTS FOR EACH OPTION

OPTION	LARGE FACILITIES NUMBER OF FACILITIES INCURRING COSTS		SMALL FACILITIES NUMBER OF FACILITIES INCURRING COSTS		ALL FACILITIES NUMBER OF FACILITIES INCURRING COSTS	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
33	1,900	2,600	15,000	16,000	17,000	19,000
100	1,100	1,800	14,000	16,000	15,000	17,000
250	870	1,300	13,000	15,000	14,000	16,000
500	700	1,100	13,000	15,000	14,000	16,000

EXHIBIT 2-12

WASTE QUANTITIES EXHIBITING THE TC

REGULATORY OPTION (DAF)	AFFECTED WASTEWATER QUANTITY (MT/YR)			AFFECTED NON-WASTEWATER QUANTITY (MT/YR)		
	LARGE	SMALL	TOTAL*	LARGE	SMALL	TOTAL*
33	830,000,000	11,000,000	840,000,000	2,900,000	200,000	3,100,000
100	720,000,000	10,000,000	730,000,000	1,600,000	160,000	1,800,000
250	690,000,000	9,100,000	700,000,000	560,000	140,000	710,000
500	650,000,000	8,800,000	660,000,000	440,000	73,000	510,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

EXHIBIT 2-13

NUMBER OF FACILITIES INCURRING COSTS (DAF 33)						
	LARGE FACILITIES		SMALL FACILITIES		ALL FACILITIES	
SIC**	NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
2231	46	48	1	1	47	49
225X	560	620	880	1,000	1,400	1,600
226X	67	69	170	180	240	250
229X	1	1	1	1	2	2
22YY	270	510	3	3	270	510
2421	18	18	59	59	77	77
26XX	130	130	23	23	150	150
2821	64	200	85	270	150	470
2822	7	7	10	11	17	18
2823	16	16	0	0	16	16
2824	4	4	1	3	5	7
283X	54	54	170	170	220	220
286	62	280	88	360	150	640
2911	220	220	0	0	220	220
2992	34	61	210	370	240	430
3031	6	6	0	0	6	6
461	29	29	200	200	230	230
517	310	310	13,000	13,000	13,000	13,000
TOTAL*	1,900	2,600	15,000	16,000	17,000	19,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERNT INDUSTRIES

EXHIBIT 2-14

NUMBER OF FACILITIES INCURRING COSTS (DAF 100)						
	LARGE FACILITIES		SMALL FACILITIES		ALL FACILITIES	
SIC**	NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
2231	39	48	0	0	39	48
225X	170	440	330	830	500	1,300
226X	58	59	150	150	210	210
2421	18	18	59	59	77	77
26XX	49	49	8	8	57	57
2821	62	200	83	270	150	470
2822	6	6	9	9	15	15
2823	16	16	0	0	16	16
2824	4	4	1	3	5	7
283X	54	54	170	170	220	220
286	62	260	88	340	150	600
2911	220	220	0	0	220	220
2992	34	61	210	370	240	430
461	29	29	200	200	230	230
517	310	310	13,000	13,000	13,000	13,000
TOTAL*	1,100	1,800	14,000	16,000	15,000	17,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 2-15

NUMBER OF FACILITIES INCURRING COSTS (DAF 250)						
	LARGE FACILITIES		SMALL FACILITIES		ALL FACILITIES	
SIC**	NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
2231	11	22	0	0	11	22
226X	24	25	62	63	86	88
2421	18	18	59	59	77	77
26XX	18	18	3	3	21	21
2821	55	200	74	200	130	400
2822	6	6	9	9	15	15
2823	16	16	0	0	16	16
2824	4	4	1	3	5	7
283X	61	61	150	150	210	210
286	62	230	88	310	150	540
2911	220	220	0	0	220	220
2992	34	47	210	290	240	337
461	29	29	200	200	230	230
517	310	310	13,000	13,000	13,000	13,000
TOTAL*	870	1,300	13,000	15,000	14,000	16,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT FACILITIES

EXHIBIT 2-16

NUMBER OF FACILITIES INCURRING COSTS (DAF 500)						
SIC**	LARGE FACILITIES		SMALL FACILITIES		ALL FACILITIES	
	NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS		NUMBER OF FACILITIES INCURRING COSTS	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
2421	17	17	57	57	74	74
26XX	3	3	1	1	4	4
2821	31	93	41	120	72	210
2822	6	6	9	9	15	15
2823	16	16	0	0	16	16
2824	4	4	1	3	5	7
283X	61	61	150	150	210	210
286	62	200	88	270	150	470
2911	120	220	0	0	120	220
2992	34	34	210	210	240	240
461	29	29	200	200	230	230
517	310	380	13,000	14,000	13,000	14,000
TOTAL*	700	1,100	13,000	15,000	14,000	16,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

The number of affected large facilities varies between 700 (minimum scenario, DAF 500) and 1,900 (maximum scenario, DAF 33). At both DAF 100 and DAF 250, all Petroleum Refineries (220) and all large Wholesale Petroleum Marketers (310) are affected by the TC. Many large Textiles mills are affected under the DAF 33 option (940 to 1,200). The number of large Textiles mills affected drops at DAF 100 (270 to 550), then to around 40 at DAF 250. No Textiles mills (large or small) are affected at DAF 500. Other industries with significant numbers of large facilities affected at DAF 100 and DAF 250 include Organic Chemicals, Plastics and Resins, Miscellaneous Petroleum and Coal Products, and Pharmaceuticals.

2.4 LIMITATIONS AND SENSITIVITY ANALYSES

This section identifies important limitations to the characterization of affected wastes and facilities, and explains the implications of the limitations. Most of the limitations to the characterization of affected wastes and facilities stem from data gaps.

2.4.1 Industries and Wastes Not Included

Perhaps the most important limitation of the characterization of affected wastes and facilities is that this RIA addresses a limited number of industries and wastestreams. Unlike hazardous waste listings, which are specific in nature, the TC is designed to identify broad categories of wastes that are hazardous. Many of the TC toxicants are common and are found in a variety of substances. TC toxicants could potentially be found in the wastestreams of hundreds of manufacturing and non-manufacturing industries. End-users as well as producers of substances containing TC toxicants may be affected by the rule.[5] As it would be impossible to quantify the full range of effects of this regulation, the Agency has concentrated on industries most likely to generate large quantities of potentially affected waste. EPA acknowledges that the industry coverage of this RIA is not complete.

The difficulty in pinpointing impacts of unusually broad scope was exacerbated by a lack of data on non-hazardous wastes. Unlike regulations for managing hazardous wastes, this regulation will affect wastes currently classified as non-hazardous. These wastes are currently outside the Subtitle C system, and requirements for information gathering related to these wastes are minimal.

Most of the available characterization data used in developing industry profiles were collected during the development of Clean Water Act Effluent Guidelines. Thus, the Agency was able to focus the most detailed analysis on wastewater treatment related wastes: aqueous wastes and associated sludges and residuals. Data on sludges were quite limited and, for the industry profiles, sludge concentrations were often predicted based on associated wastewater concentrations. Data on other process residuals and on wastes associated with the end use of substances containing TC toxicants are extremely scarce and few wastes of this type were analyzed. Some other types of wastestreams that could possibly be affected by the TC are not included (e.g., contaminated soils).

---

[5] For example, although vehicle maintenance facilities do not manufacture waxes and solvents, they may use them in their operations. It is conceivable that a vehicle maintenance facility could generate wastes, such as washwater and spent products, that contain TC constituents due to the use of the waxes and solvents.

TC regulatory levels are not being promulgated as cleanup trigger levels or cleanup standards for hazardous site cleanups under RCRA or CERCLA. The TC will, however, be applicable to wastes generated during cleanup of sites. Some excavated soils or other contaminated media generated during CERCLA cleanups or RCRA corrective actions may exhibit the TC and thus require management under Subtitle C. However, most wastes generated during cleanup of hazardous RCRA or CERCLA sites are already managed as hazardous. The TC is not expected to result in significant impacts on the costs of RCRA or CERCLA cleanups.

2.4.2 Predicting the Behavior of Oily Wastes in the TCLP

Wastes that are oily in nature behave differently when analyzed in the TCLP than other non-oily sludges and solids. Actual TCLP results have shown that wastes composed of an oily matrix may escape TC regulation due to difficulties in performing the leaching procedure. Technical difficulties during the filtration step of the TCLP may result in either non-leaching of hazardous constituents contained in the oil phase of the waste or the inability to obtain reproducible results.

The results presented in Section 2.2 and 2.3 assume that oily sludges behave like other non-oily solids in the TCLP test. This would tend to result in an overestimate in the quantities of affected wastes and number of affected facilities. The non-aqueous wastes considered in this analysis in the Petroleum Refining, Wholesale Petroleum Marketing, and Petroleum Pipelines industries are almost all oily in nature.[6] These oily wastes constitute about 50 percent of affected non-wastewaters under the DAF 100 option and over 30 percent of affected non-wastewaters under the DAF 250 option. The Petroleum Refining industry generates the largest quantity of oily wastes of any industry considered in the RIA.

Given the potential importance of an overestimate of affected wastes and facilities, EPA calculated lower bound estimates assuming that no oily wastes will exhibit the TC. Under the lower bound assumption for the DAF 100 option, only about 850,000 MT/yr of non-wastewaters will be affected by the rule. In reality, it is likely that some oily sludges will exhibit the TC, even considering filtration problems. Further, if test results are not reproducible and wastes do contain TC constituents in relatively high concentrations, it is likely that some generators would be obligated to manage their wastes as hazardous based on their knowledge of any hazardous characteristics of the waste (40 CFR 262.11(c)(2)).

2.4.3 Waste Quantities Exhibiting the TC

EPA estimated the portion of each wastestream that would exhibit the TC by assuming a direct correlation of constituent concentrations in any given wastestream. In other words, the Agency assumed that the highest concentrations of one constituent are present along with the highest concentrations of other constituents in the wastestream and, therefore, that the wastestream would fail for only a single driving constituent. After every constituent in a wastestream had been compared with the corresponding critical concentration, the constituent that resulted in the largest percent exhibiting the TC was picked as the driving constituent. This largest percent was multiplied by the total quantity of the wastestream to estimate the quantity that exhibits the TC. EPA tested the sensitivity of the results to the direct correlation assumption, for the DAF 100 option, by adding percentages of waste exhibiting the TC for each constituent instead of picking a driving constituent. This sensitivity analysis assumed a perfect inverse correlation. The analysis showed that results are very insensitive to the driving constituent assumption. For most wastestreams, either 1) only the chosen driving constituent is present at levels above TC regulatory levels, or 2) all of the wastestream would be brought into the system by virtue of the driving constituent. For the case where all of a wastestream is brought into the system by virtue of the driving constituent, there may be other constituents present at levels above their respective TC regulatory levels.

---

[6] Spent catalysts and fines and secondary treatment sludges in the Petroleum Refining industry are not oily.

2.4.4 Wastewaters Managed in Surface Impoundments

As mentioned earlier, the Agency used data from the Screening Survey of Industrial Subtitle D Establishments to estimate industry-specific percentages of large and small facilities managing wastewaters in surface impoundments, and also applied these percentages to the total wastewater quantities generated. For sensitivity analysis, EPA assumed all wastewaters are managed in surface impoundments, to produce an upper bound of affected wastewater quantities. The DAF 100 option was examined. When it was assumed that all facilities generating wastewaters are currently managing them in surface impoundments, affected wastewater quantities increased significantly.

2.4.5 Distribution of Affected Waste Quantities to Large and Small Facilities

For sensitivity analysis, the Agency assumed 50 percent of affected waste was generated by large facilities and 50 percent was generated by small facilities. This distribution is significantly different than the initial waste generation distribution assumption, which assumed that waste generation was proportional to value of shipments for large and small facilities. Using the value of shipments assumption, large facilities accounted for over 98 percent of waste generation. As defined by the 50 employee cutoff, data indicated that there are no small facilities in the Petroleum Refining and Cellulosic Synthetic Fibers industries. This sensitivity analysis did not affect these industries. The equal waste distribution sensitivity assumption changes large and small facility waste generation most significantly in those industries for which value of shipments for large facilities was much greater than 50 percent. Value of shipments for large facilities was over 90 percent of total industry value of shipments for all industries except three: Miscellaneous Petroleum and Coal Products, Petroleum Pipelines, and Wholesale Petroleum Marketing.

2.4.6 Percentage of Facilities Affected

For the RIA, EPA assumed that the percentage of facilities affected by the TC rule equalled the percentage of waste, generated by those facilities, that exhibited the TC. For sensitivity analysis, instead of linking the estimate of the number of facilities affected to the percentage of waste that exhibited the TC, the Agency assumed (1) that 10 percent of facilities are affected and (2) that 90 percent of facilities are affected.[7]

The analysis was much more sensitive to the first alternative assumption (setting percentages affected to 10 percent) than to the second (setting percentages to 90 percent).

---

[7] If all or none of a wastestream exhibited the TC, all or no facilities were considered affected and the alternative percentages were not assumed.

Setting percentages to 10 percent for the DAF 100 option reduced the number of affected facilities across industrial sectors by up to 30 percent, while setting percentages to 90 percent resulted in about a 5 percent decrease. For most wastestreams that exhibit the TC, over 90 percent of the wastestream fails.

CHAPTER 3

COSTS

Chapter 3 describes the methodology used to estimate the cost of the Toxicity Characteristic (TC) Rule. The chapter defines the costs relevant to EPA's analysis of the TC Rule and explains the model used to estimate costs of the rule. It also presents the results generated by the model in terms of both social costs and compliance costs to industry, and discusses factors driving the costs results. Also, possible numbers of new RCRA permit applications and permit modifications are estimated in the discussion of the cost model's predictions of compliance practices. Potential costs associated with used oil are discussed. Finally, the limitations of the cost analysis and relevant results of sensitivity analyses are presented. Exhibit 3-1 summarizes the approach for estimating costs of the TC rule.

3.1 DEFINITION OF COSTS

EPA analyzed the incremental costs of the TC Rule in terms of both social costs and compliance costs to industry expressed as revenue requirements. These terms are defined below.

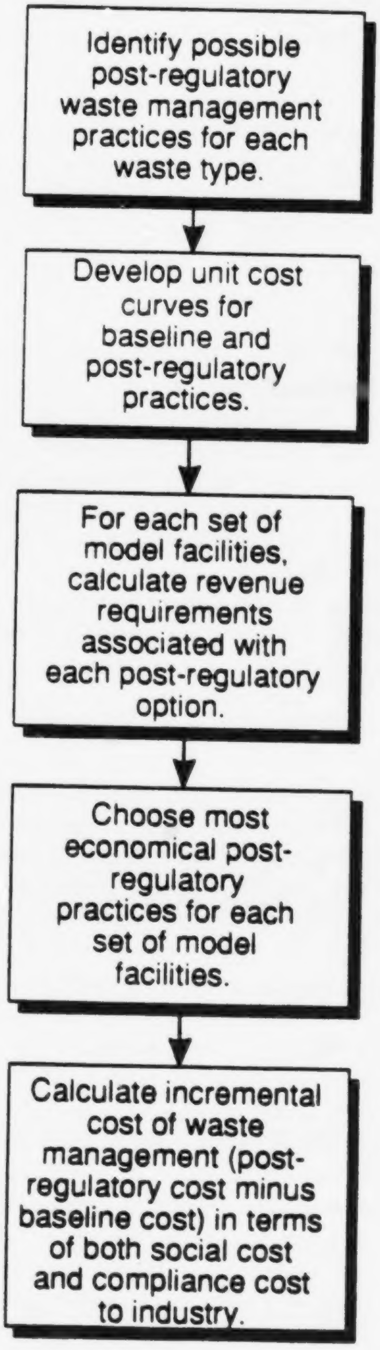
The Agency, in order to calculate the incremental costs of the TC Rule, concentrated on two different types of costs: social costs and costs to industry expressed as revenue requirements. Social costs are a measurement of the loss to society of goods and services that would be available if an activity - in this case, the management of certain wastes as hazardous wastes - were not pursued. In more practical terms, these are the total costs of the activity minus any transfer payments (including taxes). For example, an owner/operator of a Subtitle C landfill may charge $200 per metric ton to dispose of hazardous waste in his or her landfill. If the actual cost to the owner/operator is only $105, the additional $95 dollars is a transfer payment from the generator to the owner/operator and does not add to social cost, as this money can be spent on a good or service at a later date.

Taxes are another form of transfer payment. Resources collected by the government in taxes will later be transferred back into society and are not lost to society. Thus, an important distinction can be made between before-tax costs and after-tax revenue requirements. Before-tax costs of an activity are closely associated with social costs, while after-tax revenue requirements measure the necessary income that must be generated by an owner/operator to offset the newly incurred costs and maintain the same profits. These revenue requirements, or compliance costs to firms, are what will govern an owner/operator's economic decisions. The Agency used compliance costs of new waste management practices when assessing management practice alternatives because compliance costs for firms are what ultimately influence profits. EPA also used compliance costs to assess economic impacts (Chapter 4).

Social costs may be less than revenue requirements because they do not include transfer payments. However, social costs will not always be lower than revenue requirements since tax considerations affect the actual cost to the owner/operator. Specifically, capital improvements can be depreciated for tax purposes while operating and

Exhibit 3-1

Estimating Costs of the TC Rule


Identify possible post-regulatory waste management practices for each waste type.
Develop unit cost curves for baseline and post-regulatory practices.
For each set of model facilities, calculate revenue requirements associated with each post-regulatory option.
Choose most economical post-regulatory practices for each set of model facilities.
Calculate incremental cost of waste management (post-regulatory cost minus baseline cost) in terms of both social cost and compliance cost to industry.

maintenance costs can be claimed as expenses. The costs associated with those items still exist, but the government has made a transfer payment to the owner/operator in the form of "tax breaks" that reduce the revenue requirements necessary to offset the costs of the improvements. Social costs are difficult to measure because factors such as above-average profits must be accounted for. For this reason, the social costs measured in the RIA are only an approximation of actual social costs. Further details on the difference between social cost and after-tax revenue requirements can be found in Appendix C.

The Agency was concerned with only the new social and compliance costs that would be incurred as a direct result of the TC rule. Therefore, EPA calculated the cost of managing the affected wastestreams under the TC rule and subtracted the current cost of managing the same wastes. This gives an incremental cost associated with the TC rule.

3.2 METHODOLOGY

The Agency used a computer model to estimate the impacts of the TC Rule. First, as described in Chapter 2, EPA estimated the quantity exhibiting the TC for each wastestream in the analysis. The Agency then distributed the wastestreams exhibiting the TC among the facilities in the corresponding industries. EPA distributed wastes to model facilities using two different algorithms, one which minimized the number of facilities generating the affected wastes and one which maximized the number of facilities generating the affected wastes. Finally, the Agency calculated the incremental cost incurred by each set of model facilities and the resultant economic impacts. The remainder of this chapter describes the methodology used to calculate costs, given the characterization of wastes and affected facilities outlined in Chapter 2, and provides the results of the cost analysis. Resulting economic impacts are discussed in Chapter 4.

3.2.1 Unit Costs for Management Practices

As described in Section 3.1.1, the Agency examined the incremental cost of the TC Rule in terms of both social costs and compliance costs in order to determine the potential impacts of the TC. EPA developed unit costs (1988 dollars/metric ton) of managing wastes for each management practice in both the baseline and the post-regulatory situations. In some cases, such as managing wastewaters in tanks and sludges in on-site landfills, unit costs were based on cost curves and were dependent on the quantity of waste managed using that practice. In other cases, such as management of sludges in off-site landfills or land treatment facilities, the cost was a flat rate per metric ton. Appendix C details the methods used for the development of these unit costs and presents the unit costs and cost curves used in this analysis.

3.2.2 Choosing Post-Regulatory Management Practices

Baseline (i.e., pre-regulatory) management practices are discussed in Chapter 2. EPA simulated the selection of post-regulatory practices by totalling the quantities of waste of each type for each set of model facilities and choosing the least expensive method of managing that waste type. Thus, if a facility generated four different wastewaters, it would co-manage those wastewaters and reap the benefits of economies of scale.

Once wastes of similar types had been totalled, EPA assumed that a generator would choose to manage those wastes in the most economical manner available, based on compliance costs. Compliance costs for each management practice represent the actual cost to the decision-making party and have a direct impact on firm profits.

Exhibit 3-2 presents the assumptions used in this analysis about the current (baseline) waste management practices and the options available for owner/operators as post-regulatory waste management practices. For further discussion about current waste management practices see Section 2.1.3 in this RIA. For further discussion of the post-regulatory waste management options see Sections 3.2.3 and 3.2.4 below.

3.2.3 Post-Regulatory Practices: Wastewaters

Post-regulatory costs for wastewaters in this analysis are based on the cost of management in tanks exempt from Subtitle C requirements. EPA also examined costs of underground injection and dilution as potential compliance practices, but did not assign these costs to any facilities because the estimated costs were significantly higher than for management in exempt tanks. A brief summary of underground injection and dilution costs follows.

EPA estimated that large quantities of hazardous wastewater cost about $7 per metric ton to inject underground. Comparing this with less than $0.50 per metric ton for managing wastewaters in exempt tanks indicates that waste handlers would select tanks over underground injection. It is worth noting that there are many factors beyond the scope of EPA's analysis which could make underground injection a viable alternative for some facilities. These factors include geographic location, treatment that would be necessary to meet NPDES requirements, dual use of wells or drilling equipment in certain industries, and waste properties not characterized in TC data.

EPA estimated that diluting a waste with one part water to one part waste would be less costly than management in exempt tanks for quantities in excess of 300,000 metric tons per year. The Agency examined data for each wastewater affected by the TC Rule and concluded that a 1 to 1 dilution of these wastewaters would not change their status under the TC rule since the resulting constituent concentrations would still cause the wastes to exhibit the TC. A greater dilution ratio would not be more economical than tank management for any quantity.

While it is conceivable that specific facilities might find underground injection or dilution to be desirable alternatives, Agency cost estimates indicate that, in general, management in exempt tanks is significantly less costly. Thus, post-regulatory costs for all wastewaters are based on the cost of management in exempt tanks.

3.2.4 Post-Regulatory Practices: Non-Wastewaters

EPA examined on-site landfills, on-site land treatment, and the use of off-site hazardous waste facilities as post-regulatory options for sludges, slurries, and solid residuals. The Agency included the costs of complying with relevant RCRA requirements for owner/operators in its analysis of on-site Subtitle C waste management costs. These costs include waste analysis, personnel training, contingency plan preparation, liability insurance, permit application, and closure plan development and execution. For off-site

EXHIBIT 3-2

MANAGEMENT PRACTICE ASSUMPTIONS

WASTE TYPE	BASELINE	POST-REGULATORY
Wastewater	Surface impoundment or Practice permissible under Subtitle C (tank followed by NPDES or POTW discharge, indirect or direct discharge without treatment, or recycle)	Exempt tanks or Discharge to POTW
Sludge/slurry	On-site landfill or On-site land treatment unit or Off-site landfill	Off-site Subtitle C landfill or On-site Subtitle C landfill or On-site Subtitle C land treatment unit
Solid residual	On-site landfill or Off-site landfill	Off-site Subtitle C landfill or On-site Subtitle C landfill
Organic Liquid	Practice permissible under Subtitle C	Identical to current practice

management of non-wastewaters, EPA used the cost charged by commercial facilities (plus transportation costs) to calculate compliance costs to generating facilities. EPA used an estimate of the waste management cost to the commercial facility (lower than price charged) in the calculation of social costs.

In addition to incorporating normal operating expenses for on-site Subtitle C management, the Agency also incorporated expected costs for RCRA corrective action. Expected corrective action costs are included in the price of off-site Subtitle C management. To assess expected corrective action costs associated with on-site management, EPA used data from the Corrective Action Regulatory Impact Analysis to estimate the expected corrective action costs for a TC waste handler choosing to enter the Subtitle C system as a TSDF. Based on information in the Corrective Action RIA, the Agency assumed that approximately 31 percent of all new Subtitle C facilities would trigger corrective action at some point in time. Approximately 12 percent would trigger corrective action immediately and 19 percent would trigger corrective action sometime in the life of the facility. The remaining 69 percent of the facilities would not trigger any corrective action and were not assigned corrective action costs. The Agency assumed that facility owner/operators can determine whether they will trigger corrective action based on existing facility conditions. Based on this assumption, the Agency added the present value of corrective action costs (annualized at a discount rate of 9 percent for compliance costs and 3 percent for social costs) to the yearly cost of on-site management for 31 percent of the facilities. Thus, those model facilities choosing on-site management as the least costly method of managing sludges, slurries, and solid residuals incorporate expected corrective action costs into the decision.

3.2.5 Calculating Incremental Cost

Once a compliance practice had been selected using compliance revenue requirements, EPA calculated both the incremental social costs and incremental revenue requirements (i.e., compliance costs) for each facility. By summing the incremental costs for each facility, the Agency was able to estimate the total incremental social cost of the TC Rule and the incremental compliance costs to each industry included in the analysis.

3.3 RESULTS

The Agency estimated costs based on two potential distributions of wastes exhibiting the TC. One distribution concentrates all waste exhibiting the TC in an industry in as few facilities as possible and the other distributes waste exhibiting the TC over as many facilities as possible. The two distributions yield different costs for model facilities in each industry. A concentrated distribution (i.e., distributing to as few facilities as possible) tends to result in greater economies of scale. Both distributions estimate the costs for the same quantities of waste and the same number of wastestreams; the independent variable between the two distributions is the number of facilities affected by the TC Rule. As it turns out for the options considered, costs corresponding to the minimum number of facilities affected and maximum number facilities affected were identical or very close to each other for all industries. This indicates that costs are proportional to the quantities of waste that exhibit the TC, and are relatively insensitive to the distribution of TC wastes among affected facilities.

Therefore, only one set of costs are presented in the following section – those corresponding to the maximum facilities affected scenario.

3.3.1 Total Annual Social Costs

EPA calculated the total annual social costs for each of the four regulatory options. The costs, expressed in 1988 dollars, are presented in Exhibit 3-3.

The predicted annual social costs of the TC range from $52 million at DAF 500 to $270 million at DAF 33. Annual social costs at DAF 100 ($190 million) are almost three times higher than at DAF 250 ($67 million). The drop in social costs from DAF 100 to DAF 250 is mainly attributable to a decrease in the number of wastestreams that exhibit the TC under each option. Approximately 150 wastestreams are affected under the DAF 100 option while 120 exhibit the TC at DAF 250. In addition to 30 wastestreams dropping out of regulation from DAF 100 to DAF 250, some wastestreams regulated under both options have a smaller percentage affected under the DAF 250 option.

3.3.2 Annual Compliance Costs to Industry

Compliance costs to industry differ from social costs because the costs to industry include the transfer payments paid by facility owner/operators such as taxes and off-site hazardous waste management facility profits. Annual compliance costs to industry are the actual operating costs that owner/operators must face each year as a result of the TC Rule. The total compliance costs to industry for the four regulatory options are presented in Exhibit 3-4.

The total annual compliance costs to industry range from $82 million under the DAF 500 option to $350 million at DAF 33. Costs more than double from DAF 250 ($110 million) to DAF 100 ($250 million). The difference in costs between DAF 100 and DAF 250 can be traced to the difference in non-wastewater quantities between the two options, as will be further discussed in Section 3.3.5. These compliance costs represent the total amount of additional revenue that industry would have to generate annually in order to comply with the TC Rule without reducing profits. The economic impacts on facilities resulting from these costs are discussed in Chapter 4.

Although 90 to 95 percent of the model facilities affected by this rule are small facilities, only about 10 to 20 percent of the total costs to industry are incurred by small facilities. Small facilities incur costs of nearly $35 million for the DAF 33 option, approximately $28 million for the DAF 100 option, about $25 million for the DAF 250 option, and around $13 million for the DAF 500 option. Large facilities, which comprise five to 10 percent of affected facilities, incur 80 to 90 percent of the total costs to industry. Large facilities incur approximately $320 million in compliance costs under the DAF 33 option, nearly $220 million under the DAF 100 option, about $89 million under the DAF 250 option, and $68 million under the DAF 500 option.

The fact that a relatively small number of large facilities incurs the majority of compliance costs may, to some extent, result from analytical assumptions made in the RIA concerning distribution of waste to affected facilities. EPA tested the sensitivity of results to these assumptions; further discussion is found in Section 3.4.7.

EXHIBIT 3-3

ANNUAL SOCIAL COSTS TO INDUSTRY FOR EACH OPTION	
OPTION	SOCIAL COSTS ($ MILLIONS)
33	270
100	190
250	67
500	52

EXHIBIT 3-4

TOTAL COMPLIANCE COSTS FOR EACH OPTION

OPTION	LARGE FACILITIES			SMALL FACILITIES			ALL FACILITIES
	TOTAL COST TO INDUSTRY	NUMBER OF FACILITIES INCURRING COSTS		TOTAL COST TO INDUSTRY	NUMBER OF FACILITIES INCURRING COSTS		TOTAL COST TO INDUSTRY
		MINIMUM	MAXIMUM		MINIMUM	MAXIMUM	
33	320,000,000	1,900	2,600	35,000,000	15,000	16,000	350,000,000
100	220,000,000	1,100	1,800	28,000,000	14,000	16,000	250,000,000
250	89,000,000	870	1,300	25,000,000	13,000	15,000	110,000,000
500	68,000,000	700	1,100	13,000,000	13,000	15,000	82,000,000

TOTALS FOR ALL FACILITIES MAY NOT ADD DUE TO ROUNDING

3.3.3 Distribution of Compliance Costs Across Industries

Exhibits 3-5 through 3-8 present the distribution of annual compliance costs among affected industries. The split between costs associated with wastewaters and non-wastewater costs is shown. Under all options, five or six major industrial sectors incur over 90 percent of total costs. Petroleum Refining, Pulp and Paper, and Wholesale Petroleum Marketing are the three industries incurring the largest costs (about 70 percent of total) under the DAF 33 and DAF 100 options. Wholesale Petroleum Marketing, Synthetic Fibers, and Organic Chemicals are the three industries predicted to experience the largest costs (approximately 60 percent of total) under the DAF 250 and DAF 500 options.

The Petroleum Refining industry incurs the largest costs of any industry under the DAF 33 options ($140 million) and DAF 100 option ($99 million.) Costs for the Petroleum Refining industry drop to $17 million for the DAF 250 option, and to $9 million under the DAF 500 option. There is also a significant variation of costs among options for the Pulp and Paper industry. The Pulp and Paper industry incurs costs of about $85 million under the DAF 33 option, dropping to half that ($42 million) at DAF 100. Costs to the Pulp and Paper industry are only about $3 million at DAF 250 and $530,000 at DAF 500.

Costs to the Wholesale Petroleum Marketing industry differ by about a factor of three from the least stringent option ($12 million) to the most stringent option ($30 million). Wholesale Petroleum Marketing costs are similar for the DAF 100 ($25 million) and DAF 250 ($24 million) options. Costs to the Synthetic Fibers industry are estimated to be the same ($22 million) for all four options. Other industries that incur a significant portion of costs for the DAF 100 and DAF 250 options are Organic Chemicals, Pharmaceuticals, and Synthetic Rubber.

3.3.4 Factors Driving Costs

Although the quantity of waste exhibiting the TC is driven by wastewaters, the cost of complying with the TC Rule is driven by sludges, slurries, and solid residuals. The incremental compliance cost of managing sludges, slurries and solid residuals ranged from about 75 to 200 dollars per metric ton. However, the incremental cost of managing wastewaters was 0.01 to 0.53 dollars per metric ton. Non-wastewater costs account for over 95 percent of total costs. Thus, those industries with large quantities of sludges, slurries, and solid residuals incur the highest annual compliance costs and those constituents that cause the most sludges, slurries, and solid residuals to exhibit the TC can be considered the cost driving constituents.

Sludges from Petroleum Refining, Wholesale Petroleum Marketing, Synthetic Fibers, Organic Chemicals, and Synthetic Rubber all exhibit the TC mainly due to the presence of benzene. Thus, benzene is the driving constituent for wastestreams associated with at least 70 percent of total costs for DAF 100 and 80 percent of total costs for DAF 250. Chloroform, vinyl chloride, and carbon tetrachloride are the other notable cost driving constituents for these two options.

3.3.5 Cost Model Predictions of Compliance Practices

Using its cost model which compares compliance costs of each post-regulatory waste management option, the Agency predicted that the vast majority of model facility

EXHIBIT 3-5

COSTS TO INDUSTRY SPLIT BY WASTEWATERS AND NON-WASTEWATERS (DAF 33)

SIC	INDUSTRY	WASTEWATER COST	NON-WASTEWATER COST	TOTAL COST
22	TEXTILE MANUFACTURING	800,000	14,000,000	15,000,000
2421	SAWMILL AND PLANNING MILL AND FINISHING	820	0	820
26	PULP AND PAPER MILLS	360,000	84,000,000	85,000,000
2821	PLASTICS MATERIALS AND RESINS	310,000	5,300,000	5,600,000
2822	SYNTHETIC RUBBER	200,000	8,300,000	8,400,000
2823,4	SYNTHETIC FIBERS	350,000	22,000,000	22,000,000
283	PHARMACEUTICALS	330,000	17,000,000	17,000,000
286	ORGANIC CHEMICALS	730,000	25,000,000	25,000,000
2911	PETROLEUM REFINING	4,000,000	130,000,000	140,000,000
2992	MISCELLANEOUS PETROLEUM AND COAL PRODUCTS	0	7,900,000	7,900,000
30	RUBBER AND MISCELLANEOUS PLASTIC PRODUCTS	0	6,100	6,100
461	PETROLEUM PIPELINES	59,000	3,200,000	3,300,000
517	WHOLESALE PETROLEUM MARKETING	1,000,000	29,000,000	30,000,000
TOTAL*		8,200,000	350,000,000	350,000,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

FOOTNOTE: COSTS CORRESPOND TO THE SCENARIO WITH THE MAXIMUM NUMBER OF FACILITIES AFFECTED

EXHIBIT 3-6

COSTS TO INDUSTRY SPLIT BY WASTEWATERS AND NON-WASTEWATERS (DAF 100)

SIC	INDUSTRY	WASTEWATER COST	NON-WASTEWATER COST	TOTAL COST
22	TEXTILE MANUFACTURING	230,000	7,600,000	7,800,000
2421	SAWMILL AND PLANNING MILL AND FINISHING	820	0	820
26	PULP AND PAPER MILLS	35,000	42,000,000	42,000,000
2821	PLASTICS MATERIALS AND RESINS	240,000	5,100,000	5,300,000
2822	SYNTHETIC RUBBER	190,000	8,100,000	8,300,000
2823,4	SYNTHETIC FIBERS	350,000	22,000,000	22,000,000
283	PHARMACEUTICALS	270,000	14,000,000	14,000,000
286	ORGANIC CHEMICALS	600,000	20,000,000	21,000,000
2911	PETROLEUM REFINING	4,000,000	95,000,000	99,000,000
2992	MISCELLANEOUS PETROLEUM AND COAL PRODUCTS	0	5,300,000	5,300,000
461	PETROLEUM PIPELINES	60,000	2,700,000	2,800,000
517	WHOLESALE PETROLEUM MARKETING	1,000,000	24,000,000	25,000,000
TOTAL*		7,100,000	250,000,000	250,000,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

FOOTNOTE: COSTS CORRESPOND TO THE SCENARIO WITH THE MAXIMUM NUMBER OF FACILITIES AFFECTED

EXHIBIT 3-7

COSTS TO INDUSTRY SPLIT BY WASTEWATERS AND NON-WASTEWATERS (DAF 250)

SIC	INDUSTRY	WASTEWATER COST	NON-WASTEWATER COST	TOTAL COST
22	TEXTILE MANUFACTURING	20,000	2,400,000	2,500,000
2421	SAWMILL AND PLANNING MILL AND FINISHING	820	0	820
26	PULP AND PAPER MILLS	0	2,900,000	2,900,000
2821	PLASTICS MATERIALS AND RESINS	130,000	3,000,000	3,100,000
2822	SYNTHETIC RUBBER	190,000	8,100,000	8,300,000
2823,4	SYNTHETIC FIBERS	350,000	22,000,000	22,000,000
283	PHARMACEUTICALS	250,000	11,000,000	11,000,000
286	ORGANIC CHEMICALS	530,000	18,000,000	18,000,000
2911	PETROLEUM REFINING	4,000,000	13,000,000	17,000,000
2992	MISCELLANEOUS PETROLEUM AND COAL PRODUCTS	0	2,700,000	2,700,000
461	PETROLEUM PIPELINES	58,000	2,600,000	2,700,000
517	WHOLESALE PETROLEUM MARKETING	1,000,000	23,000,000	24,000,000
TOTAL*		6,600,000	110,000,000	110,000,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

FOOTNOTE: COSTS CORRESPOND TO THE SCENARIO WITH THE MAXIMUM NUMBER OF FACILITIES AFFECTED

EXHIBIT 3-8

COSTS TO INDUSTRY SPLIT BY WASTEWATERS AND NON-WASTEWATERS (DAF 500)

SIC	INDUSTRY	WASTEWATER COST	NON-WASTEWATER COST	TOTAL COST
22	TEXTILE MANUFACTURING	2,400	0	2,400
2421	SAWMILL AND PLANNING MILL AND FINISHING	780	0	780
26	PULP AND PAPER MILLS	0	530,000	530,000
2821	PLASTICS MATERIALS AND RESINS	110,000	2,300,000	2,400,000
2822	SYNTHETIC RUBBER	180,000	8,100,000	8,200,000
2823,4	SYNTHETIC FIBERS	340,000	22,000,000	22,000,000
283	PHARMACEUTICALS	220,000	10,200,000	10,400,000
286	ORGANIC CHEMICALS	502,000	14,000,000	14,000,000
2911	PETROLEUM REFINING	3,800,000	5,400,000	9,200,000
2992	MISCELLANEOUS PETROLEUM AND COAL PRODUCTS	0	2,000,000	2,000,000
461	PETROLEUM PIPELINES	60,000	1,200,000	1,200,000
517	WHOLESALE PETROLEUM MARKETING	1,040,000	11,000,000	12,000,000
TOTAL*		6,300,000	76,000,000	82,000,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

FOOTNOTE: COSTS CORRESPOND TO THE SCENARIO WITH THE MAXIMUM NUMBER OF FACILITIES AFFECTED

owner/operators would select off-site management over either on-site landfilling or on-site land treatment. Based on the cost curves used in the RIA, in order for on-site management to be economical, a facility must manage at least 6,760 MT/yr of waste in a landfill or more than 1,000 MT/yr in an on-site land treatment facility. If the facility expects corrective action costs as a result of managing waste on-site, the quantities must be even higher to make on-site management economical.

Although the number of facilities predicted to choose on-site management is relatively small, these facilities generate large quantities of waste. Using the cost model results, EPA estimates that approximately two-thirds of the total non-wastewater TC wastes will be managed on-site under the DAF 100 option; the other one-third will be sent off-site. Under the DAF 250 option, only 20 percent of affected non-wastewaters are predicted to be managed on-site and about 80 percent (500,000 MT/yr) are expected to be sent off-site. In either case, the waste quantities sent off-site for disposal (500,000 to 600,000 MT/yr) will be substantial and potentially could have an impact on the price of off-site commercial hazardous waste management.

The Agency used the cost model predictions to establish preliminary estimates of the new permit applications and permit modifications that will result from the TC rule. These estimates are presented in Exhibit 3-9. The number of facilities that will apply for new Subtitle C land disposal permits was estimated as follows: the number of facilities predicted to manage non-wastewaters on-site was multiplied by the percentage of facilities in corresponding industries that do not currently have Subtitle C treatment, storage, or disposal facility (TSDF) status. Low and high estimates correspond to the minimum and maximum facilities affected scenarios. The remaining facilities predicted to manage non-wastewaters on-site that already have Subtitle C permits or interim status are predicted to require permit modifications or changes to interim status to land dispose newly hazardous TC wastes. This number of facilities constitutes the low estimates of permit modifications in Exhibit 3-9. To derive a high estimate of permit modifications required, EPA used the total number of facilities managing non-wastewaters (on-site or off-site) that are estimated to already have TSDF status. This high estimate assumes that any interim status or permitted facility that generates newly hazardous TC wastes will require a permit modification; it includes treatment and storage facilities in addition to land disposal facilities.

3.3.6 Potential Costs Associated with Used Oil

Used oil is generated across a wide variety of industrial sectors. Some generators manage or dispose of their used oil directly while others provide their used oil to the used oil management system (UOMS), a system of intermediate collectors and processors. Firms in the UOMS then re-refine the used oil and/or sell it for various end uses.

EPA determined that three end-use management practices for used oil may be affected by the TC rule: road oiling, dumping, and landfilling/incineration. The largest affected quantity was that associated with landfilling/incineration (approximately 405,000 metric tons per year), followed by dumping (374,000 MT/year), and road oiling (232,000 MT/year).

If used oil were to become hazardous under the TC, it would probably be shifted to other end-use management practices. Much of the used oil that is currently dumped or applied directly to roads by generators would probably be collected and sold to the UOMS. Firms in the UOMS that currently sell used oil for road oiling would generally shift this oil to

EXHIBIT 3-9

RANGE OF PERMIT APPLICATIONS AND MODIFICATIONS

OPTION	PERMIT APPLICATIONS		PERMIT MODIFICATIONS	
	LOW	HIGH	LOW	HIGH
33	260	260	51	230
100	180	190	45	220
250	15	17	3	220
500	15	17	3	130

other management practices, such as re-refining or burning as a fuel. Used oil that is managed by landfilling or incineration in Subtitle D units would be shifted to management in Subtitle C units.

The shift in management practices would impose costs on used oil generators, the UOMS, and end-users of used oil. Used oil generators currently providing used oil to the UOMS would be likely to pay somewhat higher collection costs due to pass-through of compliance costs by firms in the UOMS. (These compliance costs would be associated with the disposal of used oil-related wastes, which would potentially be TC hazardous.) Generators directly managing their wastes by road oiling would incur storage and collection costs for their used oil as well as costs for a road-oiling substitute. Generators directly managing their wastes by dumping would incur costs for storage and collection. Firms in the UOMS that sell used oil for road oiling would be forced to sell the oil in less profitable markets, and some firms could close if unable to enter another market. Firms in the UOMS could also incur costs for disposal of low quality used oil and related wastes in Subtitle C (rather than Subtitle D) units if these wastes were TC hazardous. As discussed above, some of these costs could be passed on to used oil generators. Firms that re-refine used oil could benefit from the TC rule, since a greater volume of used oil would potentially be available at a lower price. Finally, end-users that purchase used oil for road oiling would incur costs for an alternative dust suppressant.

3.4 LIMITATIONS AND SENSITIVITY ANALYSES

The limitations associated with characterization of wastes and affected facilities carry over into estimates of costs associated with the TC rule. As discussed in Chapter 2, EPA conducted sensitivity analyses of the most important assumptions. The subsections below discuss focus on limitations introduced by the cost methodology itself. Some of the limitations of this analysis tend to underestimate costs of the TC rule; others tend to overestimate costs. The Agency has attempted to quantify potential overestimates or underestimates wherever possible.

3.4.1 Industries and Wastes Not Included

As noted in Chapter 2, the Agency has used available data to identify industries likely to generate large quantities of waste exhibiting the TC. Given the potentially broad scope of the rule and the scarcity of data on currently non-hazardous wastes, it is likely that some industries not addressed in this RIA may also be affected by the TC.

In addition to potentially incomplete industry coverage, there is incomplete wastestream coverage in this RIA. Wastestream analysis focused on wastewaters and associated wastewater treatment sludges. It was very difficult to locate data on other process residuals, which would be costly to manage as hazardous. There were no data readily available on some types of potentially affected wastestreams such as contaminated soils. Incomplete industry and waste coverage, as an independent factor, underestimates the costs of the TC rule.

3.4.2 Uncertainty Concerning Oily Wastes

As discussed in Section 2.4.2, this analysis may overestimate the quantities of affected non-wastewaters in three industries: Petroleum Refining, Wholesale Petroleum Marketing, and Petroleum Pipelines. Most of the sludges from these industries are oily in nature, and hazardous constituents in these oily wastes may not pass through the TCLP as readily as for non-oily wastes.

Since costs for managing sludges and solids are the driving costs of this analysis, any overestimate of the quantities of affected non-wastewaters introduces a corresponding overestimate in the cost analysis. Costs associated with oily wastes in Petroleum Refining, Wholesale Petroleum Marketing, and Petroleum Pipelines industries constitute roughly 50 percent of total costs of the rule for the DAF 33 and DAF 100 options, about 40 percent under the DAF 250 option, and 20 percent for DAF 500.

Given the significance of the potential cost overestimates just discussed, the Agency conducted a lower bound analysis by alternatively assuming that no oily wastes will exhibit the TC. Lower bound annual compliance cost estimates are $130 million for DAF 100 and $66 million for DAF 250.

3.4.3 Identification of Management Practices and Development of Unit Costs

The TC RIA cost methodology was developed to be used in the absence of facility-specific data. Baseline management practices were assigned using statistical information from the Agency's Subtitle D Screening Survey. EPA predicted post-regulatory management practices using economic logic to evaluate a range of likely waste management alternatives. Unit costs (in some cases, cost curves) were developed for both baseline and post-regulatory alternatives. The baseline and post-regulatory waste management practices and associated costs, in reality, will vary significantly for individual facilities. Factors influencing actual costs include location, total waste quantities managed and ability to co-manage wastes, existing waste management facilities available and associated capacity, and treatment necessary (for example to meet NPDES requirements). Since the Agency did not have facility-specific information, there is a substantial amount of uncertainty associated with the average unit costs used. This may result in either an underestimate or overestimate of costs.

3.4.4 Costs Not Included

Cost estimates in this RIA include costs the Agency identified as significant costs incurred when new wastes are brought into the hazardous waste system. For example, in the estimates of the cost of Subtitle C management the Agency considered items including corrective action, liability insurance, personnel training, and contingency planning. The Agency recognizes that many different cost elements, not just those related to waste management technologies, constitute significant costs.

While this RIA attempts to thoroughly assess costs industries may incur as a result of the TC, some costs are not included. In particular, EPA has not quantified the additional TCLP testing costs that may result after promulgation of the TC. There is no RCRA requirement for generators to test their wastes; the determination of hazardousness may be made based on either laboratory analysis of the waste or on knowledge of the waste, raw materials, and production processes. The Agency expects that many generators will rely on the latter method, and elect not to perform the TCLP. The Agency is still considering promulgating a testing requirement at a future date. If a testing requirement is proposed, potential costs of testing will be analyzed in detail.

Another cost, not included, that may be incurred by some facilities that choose to land dispose wastes is the cost of performing a RCRA Facility Investigation (RFI) in conjunction with the Subtitle C corrective action program. This cost was not included because it is highly variable and because the number of facilities that may incur this cost is unpredictable.

3.4.5 Waste Quantities Exhibiting the TC

As described in Sections 2.2.1 and 2.4.3, EPA tested the driving constituent assumption by adding together the percentages of the wastestream exhibiting the TC for each constituent in the wastestream. Since the quantity of waste exhibiting the TC was extremely insensitive to this assumption, all downstream results - including costs - were also insensitive to this assumption. For example, the total social costs of the rule increased by less than 1 percent under this sensitivity analysis.

3.4.6 Wastewaters Managed in Surface Impoundments

As discussed in Chapter 2, only wastewaters managed in surface impoundments are potentially affected by the TC rule. To estimate what quantities of wastewater are managed in surface impoundments and how many facilities use surface impoundments, the Agency used industry-specific percentages from the screening survey of facilities managing wastewaters in surface impoundments for both small and large facilities. These percentages were applied to both wastewater quantities and numbers of facilities generating wastewaters to estimate potentially affected waste quantities and numbers of affected facilities. EPA considered the possibility that this methodology could underestimate affected waste quantities and numbers of affected facilities.

For sensitivity analysis, EPA assumed all wastewaters are managed in surface impoundments to produce an upper bound of affected wastewater quantities and costs associated with them. As with other sensitivity analyses, the DAF 100 option results were tested. As noted in Chapter 2, this alternative assumption increased estimates of total affected wastewater quantity significantly. Increases in cost estimates, however, were not as significant. They would be potentially significant if facilities incur additional Subtitle C costs for surface impoundment closure (see Section 3.4.9).

Under the assumption that all wastewaters are managed in surface impoundments, total social costs of the rule increased by about 10 percent for the DAF 100 option. Compliance costs to industry increased for all industries generating affected wastewaters. The extent of the increase depended on whether or not there were significant costs associated with sludges in any particular industry, because sludges drove costs where there were significant sludge quantities affected. For example, for large facilities in both the Pulp and Paper sector and the Petroleum Refining sector, compliance costs increased by only about 1 percent. On the other hand, in the Hosiery and Knit Fabric Finishing sector there were very small quantities of sludge affected, and the increase in wastewater costs resulted in a doubling in total compliance costs for the sector.

3.4.7 Distribution of Affected Waste Quantities to Large and Small Facilities

In the absence of facility-specific data, waste quantities were distributed between large and small facilities using value of shipments data. This assumption tends to assign relatively small quantities of waste to small facilities, which might result in an underestimate of the costs and impacts experienced by small facilities.

In order to test the sensitivity of the waste distribution assumption, the Agency analyzed the DAF 100 option using the alternative assumption that small facilities in each industry generate 50 percent of total industry waste. (Using the value of shipments assumption, quantities assigned to small facilities ranged from one to 45 percent, with the majority being less than 10 percent.)

Using the 50/50 (portion of waste generated by small/large facilities) distribution assumption for the DAF 100 option, social costs of the rule increased by a little over five percent. The resulting general increase in estimates of social costs is attributable to lost economies of scale. When distributing wastes by value of shipments, large facilities were almost always assigned greater than 50 percent of waste generation. Wastes quantities assigned to large facilities in the initial analysis are not managed as efficiently when spread among the greater number of small facilities.

Under the 50/50 distribution assumption, compliance costs to industry generally decreased for large facilities because waste quantities per facility were smaller. The smaller waste quantities managed result in lost economies of scale for some industries; for example fewer large facilities choose to manage on-site, which indicates they no longer had an option more economical than off-site management. Compliance costs to industry increased significantly for small facilities. For example, for small facilities, in Pulp and Paper costs were 7 times higher than in the initial analysis, in Plastics and Resins 5 times higher, in Synthetic Rubber 7 times higher, and in Pharmaceuticals 10 times higher.

3.4.8 Percentage of Facilities Affected

The number of affected facilities is a determinant of the quantity of waste exhibiting the TC per facility, because affected waste quantities are spread over the number of affected facilities as described in Chapter 2. This estimate of quantity of waste exhibiting the TC per facility, in turn, is used as an input to the cost methodology.

EPA assumed that the percentage of facilities affected by the TC rule for a wastestream directly corresponds to the percentage of waste that exhibits the TC. For example, if 10 percent of a wastestream exhibits the TC, then 10 percent of the facilities generating that wastestream are potentially affected by the TC rule.[1] Clearly, if none or all of a wastestream exhibits the TC, then no facilities or all facilities are affected by the rule because of that wastestream. The Agency examined two alternative assumptions for intermediate percentages of wastestreams that exhibit the TC, for the purposes of the sensitivity analysis. The sensitivity analysis was performed on the DAF 100 option.

---

[1] For wastewaters, the number of facilities affected is further adjusted to account for the fact that only some facilities are currently managing wastes in surface impoundments.

First, EPA assumed that if an intermediate percentage (not 0 percent or 100 percent) of a wastestream exhibited the TC, then 10 percent of facilities generating that wastestream would potentially be affected. This would tend to test the implications of distributing larger quantities of waste to fewer facilities. Second, the Agency assumed that if an intermediate percentage of a wastestream exhibited the TC, then 90 percent of facilities generating that wastestream potentially would be affected. The total amount of waste affected by the TC was held constant. Thus, the two alternative assumptions give an upper and lower bound of affected facilities and associated costs.

The analysis was much more sensitive to the first alternative assumption (set intermediate percentages to 10 percent) than to the second (set intermediate percentages to 90 percent). For many industries (e.g., Sawmills and Planing mills, Plastics and Resins, Synthetic Rubber, Synthetic Fibers) wastestreams driving costs were exhibiting the TC in very large percentages. This resulted in comparatively low sensitivity to the 90 percent assumption. (If, for example, 95 percent of a wastestream exhibits the TC, assuming that 90 percent of facilities are affected was quite close to the assumption in the initial analysis.)

Setting intermediate percentages to 10 percent reduced the total social costs of the rule by 48 to 55 percent, while setting intermediate percentages to 90 percent resulted in only a one percent decrease. The significant decrease in total social costs under the 10 percent assumption resulted from economies of scale; fewer facilities are managing larger quantities of waste and doing so more efficiently than a greater number of facilities would.

Compliance costs to industry decreased very significantly under the 10 percent assumption, especially for large facilities. For example, the decrease was over 70 percent for large facilities in Pulp and Paper, Synthetic Fibers, and Petroleum Refining. Decreases were smaller in other industries, but still significant (e.g., 40 percent in Plastics and Resins, 53 percent in Synthetic Rubber, 18 percent in Organic Chemicals, and 3 percent in Wholesale Petroleum Marketing). For small facilities, the decreases in compliance costs ranged from negligible to approximately 25 percent.

Compliance costs to industry did not vary as significantly for the 90 percent assumption as for the 10 percent assumption. Also, compliance costs increased in some cases, while decreasing in others. Changes in compliance costs were generally less than 10 percent.

3.4.9 Additional Costs for Wastewaters Managed in Surface Impoundments

On the effective date of the TC, facilities managing affected wastewaters will be required to manage the wastes in a manner permissible under Subtitle C. To calculate the post-regulatory costs of managing wastewaters affected by the TC, EPA assumed that facilities would convert to wastewater tanks for management of TC wastewaters (See Section 3.2.) Wastewater treatment tanks operated by facilities subject to regulation under the Clean Water Act are exempt from Subtitle C permitting and interim status standards (40 CFR 264.1 (g)(6) and 40 CFR 265.1(c)(10)).

The Agency calculated costs presented in Section 3.3. based on the assumption that affected facilities would be able to switch from surface impoundment management to tank management for TC wastewaters within six months of the promulgation of the final rule (i.e., by the effective date of the rule). As an upper bound scenario, the Agency examined the possibility that some facilities could not accomplish the switch to tank management by the effective date of the rule. These facilities would incur additional costs.

EPA examined potential additional costs to facilities not able to switch to tank management by the effective date of the rule based on the following scenario:

- Facilities choose to install new wastewater tanks for management of wastewaters that exhibit the TC, but they are not able to have the new units operable by the effective date of the rule.
- Facilities either obtain interim status by submitting a Part A permit application (newly regulated facilities), obtain permit modifications (permitted facilities), or file amended Part A permit applications (interim status facilities) in order to continue surface impoundment management.
- For the period of time between the effective date of the rule and the operation date of new units, surface impoundment management continues.
- Since surface impoundments used for managing the waste newly designated as hazardous under the TC will have received hazardous waste, they will require Subtitle C closure.
- Some facilities newly brought into the RCRA Subtitle C system may require corrective action, either immediately or in the future.

This scenario represents a least-cost scenario for facilities that are not able to install operable wastewater treatment tanks within six months. Other options exist, e.g., construction of new Subtitle C surface impoundments or retrofitting existing surface impoundments within four years to meet Subtitle C minimum technology requirements, but in most cases these would be more costly than the above scenario.

The upper bound analysis consisted of two basic steps:

- Estimate the number of facilities that might not be able to achieve tank management of TC wastewaters within six months.
- Estimate the additional costs incurred by facilities that would be unable to install operable tank units within six months.

The specific methodology and assumptions used to conduct these steps of the upper bound analysis are detailed in Appendix H. Under the DAF 100 option, 175 facilities are estimated to incur additional costs for TC wastes managed in surface impoundments; 168 facilities are predicted to incur additional costs under the DAF 250 option. Exhibit 3-10 presents upper bound annual compliance cost estimates, based on adding extra costs for TC wastes managed in surface impoundments, for the DAF 100 option and DAF 250 options. Compliance costs increase by 60 percent under the DAF 100 option, and more than double under the DAF 250 option.

EXHIBIT 3-10

TOTAL COSTS TO INDUSTRY FOR EACH OPTION ($ MILLION)

OPTION	WASTEWATER COST	WASTEWATER COST WITH ADDITIONAL COSTS FOR SIs*	NON-WASTEWATER COST	TOTAL COST	TOTAL COST WITH ADDITIONAL COSTS FOR SURFACE IMPOUNDMENTS
100	7.1	150	250	250	400
250	6.6	150	110	110	260

*ADDITIONAL SURFACE IMPOUNDMENT COSTS INCLUDE SUBTITLE C LANDFILL CLOSURE AND EXPECTED CORRECTIVE ACTION COSTS FOR SURFACE IMPOUNDMENTS NOT ABLE TO BE CONVERTED TO TANKS WITHIN SIX MONTHS.

CHAPTER 4

ECONOMIC IMPACTS

Chapter 4 assesses the economic impacts of the final Toxicity Characteristic rule. These impacts reflect the difference between projections of industry performance in the absence of the regulation (baseline conditions) and projections of industry performance following compliance with the regulation. The imposition of the regulation will have direct impacts on an industry when compliance requires expenditures that will not contribute directly to improved operating efficiency or will require excessive price increases. In these cases, the regulation results in lower industry profits, a lower return on investment, and a reduced capacity for affected establishments to compete as sellers in product markets and as buyers in capital markets.

For each industry included in the TC RIA database, EPA collected financial data for both small and large establishments. These financial data were used with the Agency's compliance cost estimates to calculate two ratios for small and large model establishments in each industry: the cost of production ratio (COP ratio) and the cash from operations ratio (CFO ratio). The COP ratio is a surrogate for the percentage price increase necessary for a producer to pass all compliance costs through to buyers; the CFO ratio is a surrogate indicator of the ability of the producer to absorb compliance costs if no price increase is possible. EPA used these ratios to identify those facilities that may suffer significant economic impacts as a result of the TC rule.

This chapter also includes a separate assessment of impacts on small entities, as required by the Regulatory Flexibility Act (5 USC 601 et seq.). Although "small entities" are defined as including small businesses, small organizations, and small government jurisdictions, because of data limitations, only effects on small businesses were addressed in this analysis. The relative impacts of the TC rule on small and large businesses were evaluated by examining another ratio, the value of shipments ratio (VOS ratio), for establishments in each size category.

Chapter 4 first explains the methodology used by the Agency to predict economic impacts from the TC rule. Next, the overall results of the analysis are presented. The third section focuses on the analysis of impacts on small businesses. The last three sections discuss the limitations of EPA's economic impacts analysis, implications of sensitivity analyses as they pertain to economic impacts, and range estimates for economic impacts.

4.1 METHODOLOGY

EPA collected aggregate financial data for each of the Standard Industrial Classification codes (SICs) included in the RIA and derived financial parameters for small and large model facilities. These parameters were compared with estimated compliance costs to predict facility impacts. This section provides a detailed explanation of the data collection process and the ratios used in the analysis.

4.1.1 Sources of Financial Data

EPA collected financial data for this analysis primarily from the Annual Survey of Manufactures (1985), the most recent source available, and the Census of Manufactures (1982). Both references contain data by SIC code on the total number of employees, total cost of materials, total value of shipments, and total payroll for the year. However, the Census of Manufactures includes some types of data that are not reported in the Annual Survey, such as the total number of establishments in the SIC, and establishment size by number of employees. The Census also presents the financial data distributed by establishment size. EPA chose to use the more recent data from the Annual Survey, but to distribute them to small (less than 50 employees) and large (50 or more employees) establishments according to the proportions indicated in the 1982 data.

The total number of establishments for each SIC in 1985 was estimated by dividing the number of employees in 1985 by the average number of employees per establishment from the 1982 Census data. Next, to approximate the numbers of small and large facilities, EPA obtained the appropriate percentages of small and large facilities for each SIC from the Census, and applied these to the derived 1985 total number of establishments. Similarly, the 1985 total cost of materials, value of shipments, and payroll were distributed between small and large facilities in each SIC according to the corresponding 1982 distributions. The aggregate variable cost of production for each size category in each SIC was calculated by adding the appropriate values for cost of materials and payroll, and the aggregate cash from operations obtained by subtracting the variable cost of production from the value of shipments. Because EPA calculated the costs of complying with the TC rule in 1988 dollars, the producer price index (April 1988) was used to adjust all financial data to 1988 dollars.

Because SICs 461 (Petroleum Pipelines) and 517 (Wholesale Petroleum Marketing) are not manufacturing industries, data for these industries are not available in the Annual Survey of Manufactures or the Census of Manufactures. Thus, it was necessary to use alternative sources of information. For SIC 461, the Agency used data from the County Business Patterns (1985) on the number of small and large establishments, number of employees at small and large establishments, and payroll. EPA also extracted data from the Statistical Abstract of the United States 1988 for "Petroleum Pipeline Companies," using net income figures for "cash from operations," and operating revenues in lieu of "value of shipments." The cost of production was then calculated by subtracting the cash from operations value from the value of shipments. To distribute these variables to small and large establishments, EPA used the percentages of employees at small and large establishments from the County Business Patterns.

For SIC 517, EPA used the Census of Wholesale Trade (1982) to obtain the number of small and large establishments, the number of employees at small and large establishments, payroll, sales, operating expenses, and costs of goods sold. Cost of production was calculated by adding cost of goods sold to operating expenses; sales were assumed to be equivalent to value of shipments. These data were also adjusted to 1988 dollars with the producer price index (April 1988).

4.1.2 Financial Ratios

The Agency's analysis of the economic impacts of the Toxicity Characteristic rule is based on two financial ratios. The ratios were calculated on a per facility basis, using model facilities from the TC RIA database. The cost of production ratio (COP ratio) is defined as the annual compliance cost of the regulation divided by the annual variable cost of production (cost of materials plus payroll). It represents the percentage increase in product price that would be required for the establishment to pass the entire compliance cost through to consumers in the form of higher prices. If the COP ratio is greater than 0.05 (i.e., prices would have to increase by more than 5 percent) the establishment is considered to have significant impacts. Because the cost of production does not include fixed costs such as rent and costs of capital, this ratio serves as a worst-case screen. If fixed costs were added, fewer firms would be predicted to have significant impacts.

The cash from operations ratio (CFO ratio) is defined as the cash from operations (value of shipments minus variable cost of production) divided by the compliance cost. The CFO ratio represents the number of times that an establishment's cash from operations covers the regulatory compliance costs, if none of the compliance cost is passed through to buyers via price increases. If the CFO ratio is less than 20, the establishment is considered to have significant impacts. A CFO ratio less than 2 suggests a potential for closure. Because the cost of production excludes fixed costs, this ratio also serves as a screen. Establishments that have CFO ratios greater than 20 and thus show no impacts would not necessarily yield CFO ratios as high if the fixed costs were added. If fixed costs were added, more firms would be predicted to have significant impacts.

Both criteria for significance (i.e., COP > 0.05 and CFO < 20) provide a general point of reference but do not apply uniformly across industries. The ability of an establishment to pass compliance costs through to buyers depends on whether competing firms (producing identical or substitute products) incur similar costs and on overall competitive conditions in the relevant product market. Establishments that sell products in highly competitive markets may suffer significant impacts if they attempt to increase their product prices even by less than 5 percent (COP ratio < 0.05). On the other hand, the ability of an establishment to absorb compliance costs by accepting lower profits depends on how competitive the establishment needs to be in capital markets. Establishments that are involved in capital-intensive production and rely to a large extent on investment funds may have significant impacts if returns to capital fall significantly.

4.2 RESULTS OF OVERALL ECONOMIC IMPACT ANALYSIS

In this section, the Agency presents the results of its economic impact analysis in two parts. Section 4.2.1 provides estimates for each regulatory option of the total number of establishments in all industries that are expected to incur significant impacts and the number of potential closures. In Section 4.2.2, the specific industries suffering significant economic impacts from the TC rule are discussed separately, with attention given to possible changes in market conditions attributable to the impacts.

4.2.1 Number of Establishments with Significant Economic Impacts

The results of the analysis for each regulatory option are presented in Exhibits 4-1 through 4-5. Exhibit 4-5 provides a comparison of the estimated significant economic impacts across the options.

The total number of establishments predicted to experience significant impacts as a result of the final TC rule ranges from 29 under the DAF 250 and DAF 500 options to 86 under the DAF 33 option. No facility closures are expected under any of the options examined. Under the DAF 100 option, 65 facilities (51 large and 13 to 14 small) are predicted to have significant impacts. As can be seen in Exhibit 4-2, these facilities are in four industries: Pulp and Paper (SIC 26XX), Synthetic Rubber (SIC 2822), Synthetic Fibers, Cellulosic (SIC 2823), and Organic Chemicals (SIC 286). Twenty-nine facilities (21 large and 8 small) may experience significant impacts under the DAF 250 option. The 29 facilities affected under the DAF 250 option are in two industries: Synthetic Rubber and Synthetic Fibers, Cellulosic (SIC 2823). The same thirteen Synthetic Rubber facilities and 16 Synthetic Fibers, Cellulosic facilities are affected under both the DAF 100 and DAF 250 options. The difference between the DAF 100 and DAF 250 options is that 35 facilities in the Pulp and Paper industry and one facility in the Organic Chemicals industry are significantly affected under the DAF 100 option but not under the DAF 250 option. It is worth noting that the 16 facilities in the Synthetic Fiber, Cellulosic industry, which are significantly affected under all options, comprise all of the facilities in that industry.

For all of the regulatory options, the total number of large facilities with significant economic impacts is greater than the number of small facilities, by a margin of roughly three to one. This outcome appears counterintuitive, because it is generally presumed that smaller facilities have less efficient production processes and are more likely to be affected by regulatory costs than large facilities. Two reasons, however, account for the predominance of large facilities in this analysis. One is the fact that two of the industrial sectors with significantly affected establishments have many more large establishments than small establishments. The Pulp and Paper Mill sector (SIC 26XX), which is the major contributor to the pool of significantly affected facilities, includes over 5 times as many large facilities as small facilities. The Cellulosic Synthetic Fibers industry (SIC 2823), according to the extrapolations from the 1982 Census of Manufactures data, contains no small establishments at all. The second explanation for the preponderance of large facilities with significant impacts lies in the observation that, in the model used for this RIA that assumes waste quantities are proportional to value of shipments, large facilities generally produce much greater quantities of waste than small facilities, and thus would incur much higher compliance costs. Possible economies of scale, which could lower waste management costs, are not sufficient to offset the differential in compliance costs which result from differentials in waste generation quantities.

4.2.2 Industries with Significant Impacts

The industries containing establishments that may have significant economic impacts under the regulatory options presented are Pulp and Paper (SIC 26XX); Synthetic Rubber (SIC 2822); Cellulosic Synthetic Fibers (SIC 2823); and Organic Chemicals (SIC 286). Each of these industries is considered separately below, with qualitative discussion of possible effects on market conditions where appropriate.

EXHIBIT 4-1

NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT ECONOMIC IMPACTS (DAF 33)

SIC	FACILITY SIZE	TOTAL NUMBER OF ESTABLISHMENTS IN INDUSTRY	TOTAL NUMBER OF ESTABLISHMENTS INCURRING COMPLIANCE COSTS (a)	NUMBER OF ESTABLISHMENTS COP RATIO >.05	NUMBER OF ESTABLISHMENTS CFO RATIO <20	TOTAL NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT IMPACTS	NUMBER OF ESTABLISHMENTS CFO RATIO <2 (POTENTIAL CLOSURES)
26XX	LARGE	500	132	16	46	46	0
	SMALL	90	23	4	8	8	0
2822	LARGE	30	7	0	5	5	0
	SMALL	47	10-11	1	9	9	0
2823	LARGE	16	16	0	16	16	0
286	SMALL	520	88-358	0	0-2	0-2	0
TOTAL*	LARGE	550	155	16	67	67	0
	SMALL	660	121-392	5	17-19	17-19	0

(a) WHERE RESULTS FROM MINIMUM AND MAXIMUM MODEL FACILITIES SCENARIOS DIFFER, RANGE REPORTED

*TOTALS MAY NOT ADD DUE TO ROUNDING

EXHIBIT 4-2

NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT ECONOMIC IMPACTS (DAF 100)

SIC	FACILITY SIZE	TOTAL NUMBER OF ESTABLISHMENTS IN INDUSTRY	TOTAL NUMBER OF ESTABLISHMENTS INCURRING COMPLIANCE COSTS (a)	NUMBER OF ESTABLISHMENTS COP RATIO >.05	NUMBER OF ESTABLISHMENTS CFO RATIO <20	TOTAL NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT IMPACTS	NUMBER OF ESTABLISHMENTS CFO RATIO <2 (POTENTIAL CLOSURES)
26XX	LARGE	500	49	9	30	30	0
	SMALL	90	8	0	5	5	0
2822	LARGE	30	6	0	5	5	0
	SMALL	47	9	0	8	8	0
2823	LARGE	16	16	0	16	16	0
286	SMALL	520	88-338	0	0-1	0-1	0
TOTAL*	LARGE	550	71	9	51	51	0
	SMALL	660	105-355	0	13-14	13-14	0

(a) WHERE RESULTS FROM MINIMUM AND MAXIMUM MODEL FACILITIES SCENARIOS DIFFER, RANGE REPORTED

*TOTALS MAY NOT ADD DUE TO ROUNDING

EXHIBIT 4-3

NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT ECONOMIC IMPACTS (DAF 250)

SIC	FACILITY SIZE	TOTAL NUMBER OF ESTABLISHMENTS IN INDUSTRY	TOTAL NUMBER OF ESTABLISHMENTS INCURRING COMPLIANCE COSTS (a)	NUMBER OF ESTABLISHMENTS COP RATIO >.05	NUMBER OF ESTABLISHMENTS CFO RATIO <20	TOTAL NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT IMPACTS	NUMBER OF ESTABLISHMENTS CFO RATIO <2 (POTENTIAL CLOSURES)
2822	LARGE	30	6	0	5	5	0
	SMALL	47	9	0	8	8	0
2823	LARGE	16	16	0	16	16	0
TOTAL	LARGE	46	22	0	21	21	0
	SMALL	47	9	0	8	8	0

(a) WHERE RESULTS FROM MINIMUM AND MAXIMUM MODEL FACILITIES SCENARIOS DIFFER, RANGE REPORTED

EXHIBIT 4-4

NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT ECONOMIC IMPACTS (DAF 500)

SIC	FACILITY SIZE	TOTAL NUMBER OF ESTABLISHMENTS IN INDUSTRY	TOTAL NUMBER OF ESTABLISHMENTS INCURRING COMPLIANCE COSTS (a)	NUMBER OF ESTABLISHMENTS COP RATIO >.05	NUMBER OF ESTABLISHMENTS CFO RATIO <20	TOTAL NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT IMPACTS	NUMBER OF ESTABLISHMENTS CFO RATIO <2 (POTENTIAL CLOSURES)
2822	LARGE	30	6	0	5	5	0
	SMALL	47	9	0	8	8	0
2823	LARGE	16	16	0	16	16	0
TOTAL	LARGE	46	22	0	21	21	0
	SMALL	47	9	0	8	8	0

(a) WHERE RESULTS FROM MINIMUM AND MAXIMUM MODEL FACILITIES SCENARIOS DIFFER, RANGE REPORTED

EXHIBIT 4-5

NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT ECONOMIC IMPACTS
TOTAL FOR ALL INDUSTRIES

REGULATORY OPTION (DAF)	FACILITY SIZE	NUMBER OF ESTABLISHMENTS COP RATIO >.05	NUMBER OF ESTABLISHMENTS CFO RATIO <20	TOTAL NUMBER OF ESTABLISHMENTS WITH SIGNIFICANT IMPACTS	NUMBER OF ESTABLISHMENTS CFO RATIO <2 (POTENTIAL CLOSURES)
33	LARGE	16	67	67	0
	SMALL	5	17–19	17–19	0
100	LARGE	9	51	51	0
	SMALL	0	13–14	13–14	0
250	LARGE	0	21	21	0
	SMALL	0	8	8	0
500	LARGE	0	21	21	0
	SMALL	0	8	8	0

(a) WHERE TOTALS FROM MINIMUM AND MAXIMUM MODEL FACILITIES SCENARIOS DIFFER, RANGE REPORTED

4.2.2.1 Pulp and Paper Industry (only facilities with pulping operations; SIC 26XX)

In this sector, significantly affected facilities are expected under the DAF 33 and DAF 100 options. Pulp and paper mills are the most numerous type of establishment among those expected to be significantly affected under the DAF 33 and DAF 100 options. Under these two options, the Pulp and Paper industry accounts for 50 to 60 percent of establishments with significant economic impacts. No pulp and paper mill facilities are expected to close under any of the regulatory options.

SIC 26 encompasses the large number of firms which process fibers from trees, wastepapers and other materials into pulp, paper, and paperboard products. Millions of metric tons of wastes are produced during the overall production process, but EPA's analysis predicts that the wastes which will exhibit the TC are limited to those generated in one general process category--the wastewaters and wastewater treatment sludges derived from chemical pulping and bleaching operations.

The primarily Southern-based pulp mill sector is capital-intensive, which suggests that the market is difficult to enter. This factor and the expectation that demand for paper will remain strong suggest that much of the cost incurred by pulp manufacturers due to the TC can be passed on to buyers in the short term. However, domestic pulp producers are facing growing competition from foreign producers with lower labor costs and weaker local currencies, and this implies less ability to pass costs forward to buyers. Rapid expansion in the industry has created excess capacity which will only be exacerbated by predicted increases in recycling. Combined, these factors suggest that some portion of compliance costs will be passed on to buyers in the form of higher prices, and the remainder will be absorbed by pulp manufacturers in the form of lower profits.

4.2.2.2 Synthetic Rubber Industry (SIC 2822)

The numbers of establishments expected to suffer significant impacts in this industry are five large and nine small for the DAF 33 option, and five large and eight small for the other three options. In this relatively small industry (30 large and 47 small establishments total), these numbers constitute about 20 percent of the total number of facilities in the industry.

The Synthetic Rubber industry is composed predominantly of divisions or subsidiaries of major rubber product manufacturers, chemical companies, and oil companies. Its principal inputs are derivatives of crude oil or natural gas, and it is therefore designated as a petrochemical industry. Synthetic rubbers are defined as rubber-like materials produced by polymerization or copolymerization, and capable of vulcanization. There are three major operations within synthetic rubber production: emulsion crumb production, solution crumb production, and latex production. The Agency's analysis for the DAF 100 option predicts that some wastewaters from all three processes (over 99 percent of emulsion and solution crumb wastewaters, but less than one percent of latex wastewaters), as well as wastewater treatment sludges from the solution crumb process, will exhibit the TC.

The largest markets for synthetic rubber are tires and various fabricated products for motor vehicle production and use. Recently, imports of rubber products and automobiles, along with substitution of plastic materials, have suppressed domestic demand for general purpose synthetic rubbers. The promulgation of the TC could therefore significantly affect the profit levels of some synthetic rubber producers, who will likely be forced to carry most of the cost of regulation themselves. Thus far, falling petroleum prices have helped enable manufacturers to maintain profits in the face of reduced demand, but petroleum market stability is difficult to predict.

4.2.2.3 Cellulosic Synthetic Fibers Industry (SIC 2823)

EPA's analysis indicates that all establishments in the industry (16 large establishments) may face significant economic impacts under all of the regulatory options. No facilities are expected to close, however, under any of the regulatory options.

SIC 2823 contains establishments which manufacture cellulosic fibers (such as cellulosic acetate and rayon) in the form of monofilament, yarn, staple, or tow. In the production process, naturally occurring polymeric materials, such as cellulose, are dissolved or dispensed into an appropriate solvent, and then spun into fine filaments. These filaments are further processed in other textile industries on spindles, looms, knitting machines, and other equipment. EPA's analysis predicts that with a DAF of 100, over 99 percent of the wastewaters generated in the industry will exhibit the TC, primarily due to the presence of benzene in waters from the production of acetate. Wastewater treatment sludges will also exhibit the TC.

In recent years, domestic demand for synthetic fibers has been dampened by increasing apparel imports and consumer preference for natural fibers. In response, both the Cellulosic and Noncellulosic Synthetic fiber industries have reduced productive capacity, and diversified into more industrial and household product areas. The implementation of the TC could affect the industry, as higher costs drive textile manufacturers away from cellulosic synthetic fibers altogether, and toward noncellulosic and natural fibers. Unless technological adjustments make it possible to reduce the amount of hazardous waste generated, the industry is likely to experience reductions in profit levels.

4.2.2.4 Organic Chemicals Industry (SIC 286)

For the DAF 33 and DAF 100 options, one or two small establishments are expected to face significant economic impacts. Because the number of small facilities in this industrial sector is relatively large (515), these one or two significantly affected small facilities comprise less than one percent of the total number of small facilities in the industry. Agency analysis predicts no facility closures in this industry.

The Organic Chemicals industry is a leading sector of the U.S. economy, with its products feeding into hundreds of other industrial sectors. Over 90 percent of its output is based on petroleum or natural gas, and the remainder originates from coal or agricultural products. Principal products include derivatives of ethylene, propylene, benzene, toluene, xylene and methane. Because of the great diversity of organic chemicals and production processes, it was necessary to limit the evaluation of waste to that generated from the production of major chemicals, and examine only the generic early feedstock processes to identify those with currently non-hazardous wastestreams potentially containing one or more of the proposed TC constituents. EPA's analysis predicts that over half of the selected wastestreams would exhibit the TC, in portions ranging from less than one percent to over 99 percent.

The demand for the products of the organic chemicals industry has grown at a relatively modest average rate of about three percent over the last few years. Because of its major role as a supplier to other industries, growth in SIC 286 generally reflects the overall growth of the national economy. In recent years, the industry benefited from lower oil and natural gas prices, which lead to higher profit margins. Also, the decline in the value of the U.S. dollar helped the domestic industry's international trade position relative to that of foreign competitors. This latter factor may become less significant, however, as the dollar regains strength, and as energy-rich developing countries such as Saudi Arabia and Kuwait, as well as the Pacific Rim countries, develop their chemical industries. The value of the U.S. dollar has relatively little effect on the prices of chemicals exported by these countries, which have very low production costs, relative to the U.S. Unless the overall economy expands significantly, the TC will have an effect on the organic chemicals industry, as firms will be limited in how much of the cost posed by the regulation can be passed on to consumers. Domestic producers will have to squeeze profit margins in order to maintain competitiveness with foreign firms. Another induced effect might be a decrease in the demand for chemicals that are TC constituents, if chemical users switch to substitutes so that their wastes will not exhibit the TC.

4.3 SMALL BUSINESS ANALYSIS

The Regulatory Flexibility Act requires Federal agencies to analyze the effect of their regulations on small entities and to examine ways to minimize adverse economic effects on this group. The act requires agencies to prepare an initial Regulatory Flexibility Analysis (RFA) to accompany any notice of proposed rulemaking (see USC 603). A final RFA that incorporates public comment must accompany a final rule. The purpose of the RFA is to evaluate the impact of rules on small entities. The Act specifies that the RFA must identify the categories of small entities affected by the regulation and analyze alternatives that may reduce the economic burden on these small entities without compromising the goals of the rule. An exemption from the requirement for preparing a full RFA is available if the Agency can certify that the rule will not have a significant economic impact on a substantial number of small entities (see 5 USC(b)).

The Regulatory Flexibility Act defines "small entities" as including small businesses, small organizations, and small government jurisdictions. However, no organizations fitting the latter two definitions were identified in the industry and wastestream reports prepared for the TC RIA. Therefore, EPA addresses only impacts on small businesses in this analysis.

4.3.1 Criteria and Methodology

This analysis examines whether the TC rule will significantly affect a substantial number of small businesses, and hence whether a full RFA is required. EPA has issued guidelines for making this determination in accordance with the requirements of the Regulatory Flexibility Act.[1] The guidelines address procedures for:

---

[1] Memorandum from the EPA Administrator to Associate Administrators, Assistant Administrators, Regional Administrators, and Office Directors, "EPA Implementation of the Regulatory Flexibility Act," February, 1982.

- Identifying the small entities affected by the rule;
- Determining if a "substantial number" of small entities are affected by the rule; and
- Evaluating if the rule has "significant" impacts on these small entities.

The Regulatory Flexibility Act defines small businesses as those firms that satisfy the criteria established under Section 3 of the Small Business Act. The Agency may use an alternative definition of "small business" after consultation with the Small Business Administration (SBA) and public comment. The SBA criteria apply to firm size, whereas the impact analysis for this rule is conducted at the plant or facility level. For single-plant firms, the SBA criteria can be applied using information from the U.S. Census or other sources on the number of employees at the establishment level. For firms owning more than one plant, applying the SBA criterion at the firm level implies use of a lower employee definition of small business at the facility or plant level. Development of alternative size definitions for each industry would require considerable analysis of the economic structure of each industry. Lacking this detailed information, EPA used a single 50-employee cut-off to define small facilities. Financial data came primarily from the Census of Manufactures and Annual Survey of Manufactures.

As noted previously, the Regulatory Flexibility Act specifies that a full RFA is required only if a substantial number of small entities is likely to suffer significant adverse economic impacts. The Act does not specify, however, the criteria for determining if a "substantial number" of small entities are significantly affected. The Agency has established a standard threshold of 20 percent; if the proposed rule has a significant impact on 20 percent or more of the universe of small entities subject to the regulation, then an RFA is required.

The EPA guidelines suggest that four criteria be applied to evaluate whether a regulation will have a significant impact on a small entity. Satisfaction of any of the criteria indicates a significant impact. The four criteria are as follows:

1. Annual compliance costs increase the relevant production costs for small entities by more than five percent;
2. The ratio of compliance costs to sales will be 10 percent higher for small entities than for large entities;
3. Capital costs of compliance represent a significant portion of the capital available to small entities, taking into account internal cash flow plus external financing capabilities; and
4. The costs of the regulation are likely to result in closure of small entities.

In applying the first and fourth criteria, the COP and CFO ratios for small facilities were used. A COP ratio of greater than 0.05 would satisfy the first measure, and a CFO ratio of less than two would indicate closure and satisfy the fourth. The third measure, the effect of compliance costs on capital availability, was not employed, due to the absence of facility-specific data.

For the second criterion, comparing the ratios of compliance costs to sales for large and small facilities, industry-level ratios were calculated. Value of shipments (VOS) was used as a proxy for sales (the ratios are hereafter referred to as VOS ratios). Once the VOS ratios are calculated, however, the EPA guidelines are ambiguous with respect to the specific methodology of the comparison. The language of the guidelines leaves open the question of whether the test for the ten percent difference should involve the subtraction of the large facility VOS ratio from the small facility VOS ratio or the division of the small facility ratio by the large facility ratio. The division approach may be somewhat misleading, as it could indicate significant impacts on small facilities in cases where small facility compliance costs are only a minuscule percentage of sales, but the corresponding percentage is even lower for large facilities. For this reason, the subtraction approach was used in this analysis, but the division approach was examined as well.

4.3.2 Results of Small Business Analysis

The results of EPA's small business analysis for the TC rule are presented in Exhibit 4-6. The comparison of small and large VOS ratios shown in the table uses the subtraction approach. Under none of the regulatory options do 20 percent or more of small businesses suffer significant impacts according to the criteria listed above. In fact, the only regulatory option under which EPA identified any small businesses with significant impacts was the DAF 33 option, and the total number of these businesses was just 5, corresponding to a percentage of 0.01. For no industries, under any of the regulatory options, was the difference of VOS ratios larger than 10 percentage points.

Using the division approach for comparing the VOS ratios, EPA observed that small businesses in four sectors (Pulp and Paper, Synthetic Rubber, Organic Chemicals, and Wholesale Petroleum Marketing) appeared to suffer significant impacts. However, because in all cases both facility VOS ratios were low (no small facility ratio was greater than 0.03), the Agency does not consider the results of the division approach to be indicative of truly significant impacts on small facilities. The Agency concludes therefore that the TC rule will not result in significant impacts on a substantial number of small businesses, and that the performance of a full Regulatory Flexibility Analysis is not required for this rule.

4.4 LIMITATIONS AND SENSITIVITY ANALYSIS

Since cost results (Chapter 3) were used as input to the economic impacts analysis, limitations of the cost methodology carry over to the economic impacts analysis. Any significant overestimate or underestimate of costs could be paralleled by an overestimate or underestimate of economic impacts, though not necessarily of corresponding magnitude. Many of the limitations of the cost estimates stemmed from assumptions necessary in the characterization of affected wastes and facilities; the Agency conducted sensitivity analyses on the most important of these assumptions.

EXHIBIT 4-6

SMALL BUSINESSES SUFFERING SIGNIFICANT IMPACTS

Regulatory Option	COP Ratio > .05	CFO Ratio <2	VOS RATIO (small)-VOS Ratio (large) > .10	Total Number of Small Businesses With Significant Impacts	Percentage of Small Businesses With Significant Impacts
DAF 33	5	0	0	5	0.01%
DAF 100	0	0	0	0	0.00%
DAF 250	0	0	0	0	0.00%
DAF 500	0	0	0	0	0.00%

4.4.1 Financial Ratios

Due to data limitations, the two financial ratios used here to determine if establishments incur significant economic impacts are imperfect surrogates for better theoretical measures. In the case of the cost of production (COP) ratio, use of the surrogate results in an overestimation of the number of establishments that may incur significant economic impacts. In the case of the cash from operations (CFO) ratio, use of the surrogate results in an underestimation of the number of establishments that may experience significant impacts.

A major source of error in both cases is the use of cost of production estimates that exclude fixed costs such as rent, lease fees, debt service, depreciation, insurance, and professional fees. Because the estimates of COP used in the analysis do not include these costs, they are clearly lower than the true cost of production values. Similarly, the CFO estimates, because they are calculated by subtracting COP from the value of shipments (VOS), are higher than their true values.

The results of the bias introduced into the analysis by computing financial ratios on the basis of low COP estimates and high CFO estimates are as follows:

- Low COP estimates will overstate impacts because compliance costs will appear misleadingly large relative to the COP estimates, resulting in the calculation of inflated COP ratios. Compliance costs that may actually be very minor relative to total production costs (including rent, debt service, insurance, etc.), could appear to be quite high when compared to COP estimates which include only operating costs and not fixed costs.

- High CFO estimates will understate impacts because compliance costs will appear deceptively small relative to the CFO estimates, resulting in the calculation of misleadingly high CFO ratios. Establishments with high fixed costs, for which covering the cost of compliance could be a significant hardship, may not be identified.

4.4.2 Predicting Significant Impacts on Small Facilities

Within the small business analysis, in addition to the COP and CFO ratios, the subtraction and division approaches for comparing small and large facility VOS ratios could also be cited as providing a potential for misperception. As explained in Section 4.3.1, the division approach may indicate significant impacts on small businesses even when compliance costs actually represent a very low percentage of the value of shipments for small businesses, if the corresponding percentage for large businesses is even lower. For this reason, the results of this approach should be interpreted with caution. One should also be careful when using the subtraction approach, however, because it could lead to the failure to recognize significant impacts in cases where the small facility VOS ratio is very high, but less than 10 percentage points higher than the large facility ratio. For instance, a rule which imposed very high costs on all facilities in an industry (and thus significantly affected the entire industry) could result in a small facility ratio of 50 percent and a large facility ratio of 43 percent. Using the subtraction approach, which indicates small business impacts relative to large business impacts, would not indicate significant impacts for small facilities.

4.4.3 Distribution of Affected Waste Quantity to Large and Small Facilities

As previously explained (Sections 2.3.1, 2.4, and 3.4) the Agency tested the distribution of waste quantities between large and small facilities using value of shipments data by alternatively assuming 50 percent of waste is generated by large facilities and 50 percent by small facilities. In conjunction with small facilities generating larger waste quantities and incurring higher compliance costs, there were greater economic impacts for small facilities when EPA assumed that small facilities generate 50 percent of wastes. About 40 additional small facilities were affected, with around 10 potential closures.

4.4.4 Percentage of Facilities Affected

The Agency conducted sensitivity analysis on the assumption that the percentage of facilities affected by the TC equalled the percentage of total wastestream affected by alternatively assuming (1) that 10 percent of facilities generate the total affected wastestream quantity, and (2) that 90 percent of facilities generate the total affected wastestream quantity.

Economic impacts results were insensitive to the 90 percent assumption. On the other hand, the 10 percent assumption slightly decreased impacts on large facilities and increased impacts on small facilities, adding potential closures in Pulp and Paper and Synthetic Rubber. Although total compliance costs to industry generally decreased under the 10 percent assumption, costs per facility were higher, thus resulting in the increase in impacts on small facilities.

4.4.5 Additional Costs for Surface Impoundments

EPA calculated an upper bound estimate of economic impacts by assuming 175 facilities incur costs for Subtitle C closure of surface impoundments. The Agency used the upper bound compliance costs to calculate upper bound COP ratios and CFO ratios. Adding surface impoundment closure costs to compliance costs (the upper bound assumption) would cause additional facilities to be significantly affected. The upper bound estimate of significantly affected facilities for the DAF 100 option is 81 total facilities (as opposed to 65). The additional significantly affected facilities comprise the following: one large facility in the Pulp and Paper industry (a potential closure), one large and one small facility in the Synthetic Rubber industry, two large facilities in the Organic Chemicals industry, one large facility in the Textiles industry, three large facilities in the Pharmaceuticals industry, and seven large facilities in the Plastics and Resins industry.

CHAPTER 5

BENEFITS

This chapter analyzes the benefits of regulating wastes that exhibit the toxicity characteristic. The Agency examined three benefits measures: reduction in resource damage, reduction in human health risks, and reduction in groundwater cleanup costs. These benefits result from managing wastes that exhibit the TC in Subtitle C facilities rather than in unregulated management facilities.

Section 5.1 describes the methodology for estimating the benefits measures. Section 5.2 presents our results in detail for each of the benefits measures under each regulatory option. Section 5.3 discusses limitations of the methodology and Section 5.4 discusses the results of sensitivity analyses of benefits.

5.1 METHODOLOGY

This section presents the methodology for estimating reductions in adverse effects to human health and the environment under the TC rule. The methodology for estimating these benefits of the TC has two major parts. First, it determines the adverse effects resulting from the unregulated management of wastes, i.e., baseline damages. Then it determines which of these adverse effects would not be present if the wastes were regulated under the TC. The reductions in adverse effects constitute the benefits of the rule. There are seven steps (shown in Exhibit 5-1) in determining the reductions in adverse effects resulting from the regulation of wastes. These steps are described in detail below.

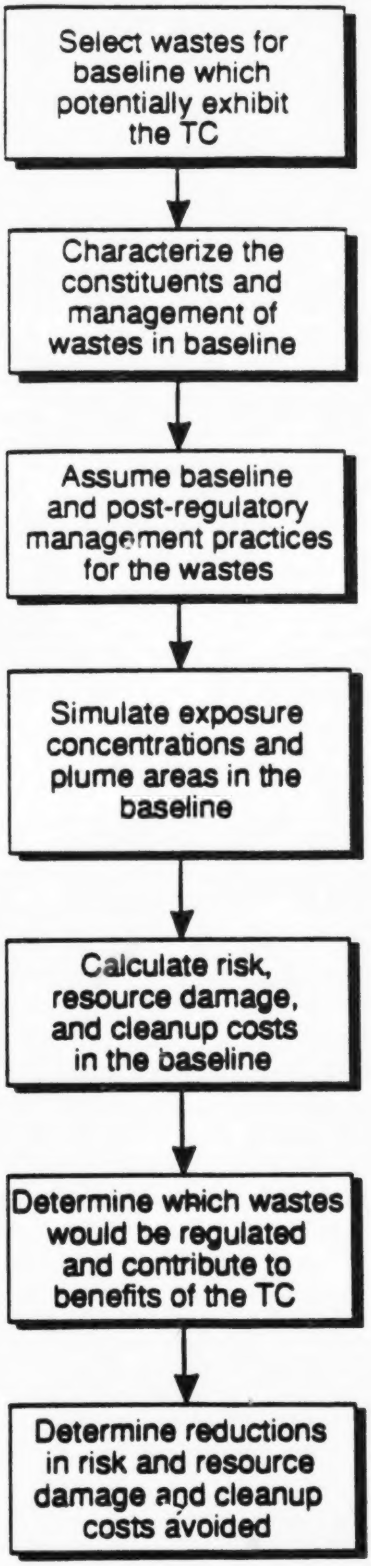
5.1.1 Selection of TC Wastes

For the benefits analysis, EPA selected a subset of the wastestreams in the TC RIA database (described in Section 2). To formulate a baseline, EPA selected those wastestreams that would be affected by the TC (i.e., wastestreams having some quantity of waste with concentrations of at least one TC constituent above the regulatory level) under the originally proposed rule (where regulatory levels were based on a dilution and attenuation factor of 14).

The resulting baseline data set consists of 218 wastestreams. Of these wastestreams 127 are non-wastewaters (i.e., sludges/slurrys or solid residuals) and 91 are wastewaters (i.e., aqueous liquids). Organic liquids are not included in this data set since management of these wastes would not be affected by the regulation.

EXHIBIT 5–1

Estimating Benefits of the TC Rule


Select wastes for baseline which potentially exhibit the TC
Characterize the constituents and management of wastes in baseline
Assume baseline and post-regulatory management practices for the wastes
Simulate exposure concentrations and plume areas in the baseline
Calculate risk, resource damage, and cleanup costs in the baseline
Determine which wastes would be regulated and contribute to benefits of the TC
Determine reductions in risk and resource damage and cleanup costs avoided

5.1.2 Characterization of Wastestreams

The wastestreams are characterized by the following information:

- Type of waste (wastewater or non-wastewater);
- Number of managing facilities;
- Constituent concentrations; and
- Risk-driving and resource damage-driving constituents.

After describing briefly all of these elements, special assumptions for the number of managing facilities and risk-driving constituents will be explained in more detail.

EPA identified the type of waste as either wastewater or non-wastewater because different management practices are required for each. Wastewaters are assumed to be managed in surface impoundments and non-wastewaters are assumed to be managed in landfills or land application units. EPA also estimated the number of facilities managing TC wastes because it is at the managing facilities that the risk and resource damage occur.

Individual wastestreams that may be subject to TC regulation are composed of multiple constituents. Only those benefits associated with regulating the 25 constituents covered by the regulatory options were assessed.

Risk-Driving Constituents. EPA determined which of the constituents in each wastestream would result in the greatest carcinogenic risk and the greatest non-carcinogenic exposure upon leaching into the ground water. These constituents are called the "risk-driving" constituents. "Resource damage-driving" constituents are closely related to them, and are defined in a similar manner.

Analyzing risk-driving and resource damage-driving constituents simplifies the benefits estimation process without substantially reducing the accuracy of the results. EPA selected risk-driving constituents by first calculating the mean concentration of each of the constituents in each wastestream. Then, the corresponding leachate concentration was calculated: for wastewaters, this is identical to the waste concentration; for non-wastewaters, this is calculated by use of the Organic Leaching Model (discussed later in this section). The Agency then calculated an exposure concentration for each constituent. The exposure concentration is calculated by dividing the leachate concentration by a DAF of 100. The exposure concentrations were then converted to doses by assuming a drinking water intake of 2 L/day and a mean body weight of 70 kg. The carcinogenic risk driver in each wastestream is the constituent with the largest risk as determined by the dose times the constituent's potency factor. The non-carcinogenic risk-driver is the constituent with the highest ratio of dose to RfD.

In all cases, the concentrations of the carcinogenic and non-carcinogenic risk drivers are assumed to be perfectly correlated with the concentration of the cost-driver. That is, EPA assumes that the 50th percentile concentration of the cost-driving constituent will occur along with the 50th percentile of the risk-drivers; the 75th percentile of the cost-driver occurs along with the 75th percentile of the risk-drivers; and so on.

After selecting the risk driving constituents for a wastestream, EPA simulated the resource damage due to both the carcinogenic and non-carcinogenic risk drivers (resource damage is defined, and our methods for analyzing it are described, later in this chapter). The risk driver with the greater simulated resource damage was designated as the ground water resource damage driver for each wastestream.

Managing Facilities. EPA estimated the number of facilities managing each wastewater and the number of facilities managing each non-wastewater independently. Then EPA adjusted these numbers to account for the fraction of those facilities believed to include both RCRA Subtitle D and Subtitle C units. Ground-water monitoring and/or corrective action activities associated with Subtitle C units are assumed to effectively prevent or remediate ground-water contamination at these sites.

In total, EPA estimates that 1,900 facilities manage wastewaters potentially exhibiting the TC in surface impoundments. EPA obtained this estimate by adding industry-by-industry estimates for each industrial sector with wastes that were characterized. The percentage of facilities managing wastewaters in surface impoundments was estimated for each sector by using waste management information from the Screening Survey of Industrial Subtitle D Facilities (Screening Survey) in conjunction with facility size information from the Census of Manufactures. Exhibit 5-2 displays estimates for each industry examined in the benefits analysis. It also shows the estimated number of managing facilities (i.e., number of facilities with on-site surface impoundments) for each industry.

For example, this exhibit shows that 11.7 percent of the facilities generating wastewaters in the Organic Chemicals Industry (SIC 286) manage the wastewaters in surface impoundments, yielding 64 facilities with surface impoundments for the industry. The percentage of 11.7 is generated by adding separate estimates for large facilities and small facilities. EPA estimated a value for large facilities managing wastes in surface impoundments at sites which are not Subtitle C facilities by multiplying the percentage of large facilities in each industry (41) by the percentage of large facilities with surface impoundments (23) and by the percentage of large facilities involved in land-management which are not Subtitle C facilities (100 minus 41.7). This large facilities percentage is added to a similar value for small facilities, which is obtained in the same manner (i.e., 0.59 times 0.13 times the difference between 1.00 and 0.188).

These estimates assume that the land-management percentages in the Screening Survey accurately describe facilities likely to generate TC wastes, although this universe of

EXHIBIT 5-2
ESTIMATION OF NUMBER OF SURFACE IMPOUNDMENTS BY SIC

SIC***	Percent of Facilities in the Industry		Percent of Facilities With Surface Impoundments		Percent of Facilities with Subtitle C units		Percent of Facilities with Only Subtitle D Surface Impoundments	Estimated Number of Facilities with Surface Impoundments
	Large	Small	Large	Small	Large	Small		
2231	37	63	15	2	1.4	0	6.8	9
225X	34	66	15	2	1.4	0	6.3	95
226X	28	72	15	2	1.4	0	5.6	23
227X	32	68	15	2	1.4	0	6.1	0
2299	6	94	15	2	1.4	0	2.8	8
229X	31	69	15	2	1.4	0	6.0	8
22XX	44	56	15	2	1.4	0	7.6	0
22YY	57	43	15	2	1.4	0	9.3	83
2421	11	89	13*	7*	9.6*	0.3*	7.5	56
2499	8	92	13*	7*	9.6*	0.3*	7.4	1
26XX	42	58	12	0.3	4.5	0	6.6	21
2821	43	57	24	1	37.0	0	7.1	39
2822	39	61	10	0.2	32.4	0	3.9	2
2823	100	0	10	0.2	32.4	0	6.8	1
2824	77	23	10	0.2	32.4	0	5.7	3
283X	29	71	13*	7*	9.6*	0.3*	8.4	52
286X	41	59	23	13	41.7	18.8	11.7	64
2911	100	0	73	13	36.1	0.3	53.9	98
2992	14	86	13*	7*	9.6*	0.3*	7.6	0
3011	51	49	3	0.4	10.1	0	1.6	0
3021	49	51	3	0.4	10.1	0	1.5	0
3031	23	77	3	0.4	10.1	0	0.9	0
3041	50	50	3	0.4	10.1	0	1.5	0
3069	29	71	3	0.4	10.1	0	1.1	0
3079	22	78	3	0.4	10.1	0	0.9	0
461	13	87	13*	7*	9.6*	0.3*	7.6	53
4911	31	69	34	15	3.7	0	20.5	0
517	2	98	10**	10**	9.6*	0.3*	10.0	1,292
							Total	1,909

---

* based on averages for all industries in the Subtitle D phone survey

** from MRI industry report for Petroleum Products Distribution and Wholesaling Systems

*** See Exhibit 2-3 for the industry names for these SICs.

facilities is somewhat different than the universe of generators of all non-hazardous industrial wastes, which was the actual population targeted by the Screening Survey.

These estimates may overstate the number of affected facilities managing wastewaters because some wastestreams in the database are generated by the same facilities, rather than being generated by different facilities and managed in distinctly different units. Due to the uncertainty in identifying which wastestreams may be generated by the same facilities, EPA assumes each wastewater wastestream is generated at an independent location. As an example of the potential difficulty this can create, assume that there are three potential TC wastewater streams generated in a particular industry. The number of facilities generating each wastestream would be multiplied by the fraction of facilities for that industry believed to manage wastewaters in unregulated surface impoundments, providing an overestimate for the number of managing facilities in that industry under some circumstances.

The number of facilities managing potential TC wastewaters in surface impoundments in each industry is listed in Exhibit 5-2 and is based on this assumption of independent facilities. The Agency believes that this assumption has not led to unreasonable estimates, in part because the estimate of 1,900 facilities is well below the total of 6,700 facilities with surface impoundments estimated to receive all industrial wastes in the Screening Survey.

EPA estimates that a total of 8,600 facilities with landfills and land application units manage non-wastewaters (i.e., sludges/slurrys and solid residuals) that are potentially TC wastes. To derive this number EPA used a somewhat different approach from the one used above for facilities managing wastewaters. This is because individual facilities frequently generate multiple sludges during the management of a single wastewater. Simply applying the percentage of generating facilities that also land-manage their sludges to each sludge wastestream would result in a large overestimate of the number of landfills and land application units used to manage these wastes.

Instead, EPA identified the total number of facilities with landfills and land application units available to receive TC wastes. These include facilities with on-site landfills and land application units as well as municipal landfills. The number of facilities with on-site units was determined from the Screening Survey and is shown and totalled in Exhibit 5-3. There are a total of 2669 facilities with on-site units.[1] This number was subsequently adjusted to remove facilities believed to already be Subtitle C facilities (6.7 percent overall) leaving an estimated 2490 on-site facilities not already covered by Subtitle C. The number of municipal landfills was obtained from the National Survey of Solid Waste (Municipal Landfill Survey) and totals 6,024 facilities.[2]

---

[1] The number of facilities with landfills may be added to the number of facilities with land application units because the Screening Survey shows that there are very few facilities which have both types of units (less than 2 percent of the facilities with units).

[2] U.S. EPA, National Survey of Solid Waste (Municipal Landfill Facilities), Final Report, Office of Solid Waste, October, 1988.

EXHIBIT 5-3

ESTIMATION OF NUMBER OF FACILITIES MANAGING NON-WASTEWATERS ON SITE

SIC	Subtitle D Industry Name	Number of Facilities with Landfills	Number of Facilities with Land Application Units	Total
2231 225X 226X 227X 2299 229X 22XX 22YY	Textile Manufacturing	25	65	90
2421	-- [a]	182	170	352
2499	-- [a]	123	91	214
26XX	Pulp and Paper	180	75	255
2821	Plastics and Resins	28	15	43
2822 2823 2824	Selected Chemicals and Allied Products	19	15	34
283X	-- [a]	38	35	73
286X	Organic Chemicals	13	24	37
2911	Petroleum Refining[b]	95	163	258
2992	-- [a]	12	11	23
3011 3021 3031 3041 3069 3079	Rubber and Miscellaneous Plastics	36	16	52

EXHIBIT 5-3 (continued)

ESTIMATION OF NUMBER OF FACILITIES MANAGING NON-WASTEWATERS ON SITE

SIC	Subtitle D Industry Name	Number of Facilities with Landfills	Number of Facilities with Land Application Units	Total
461	-- [a]	16	15	31
4911	Electric Power Gen.	126	34	150
517	-- [a]	542	505	1047
	Total	1435	1234	2669

[a] based on averages for all industries in the Screening Survey

[b] based on data from the Census of Manufactures.

To determine the number of facilities managing a particular non-wastewater wastestream, the analysis apportioned the 8,600 landfills and land application units over the generators of non-wastewaters in proportion to the number of generators of each sludge or solid residual. The generators of non-wastewater wastes sum to 79,600 facilities. Therefore, the reduction factor applied to the number of generators of each wastestream is 0.108 (i.e., 8,600 divided by 79,600).

For example, there are two sludges generated by facilities in the Miscellaneous Plastics Products Industry (SIC 3079). Each sludge is generated by 11,653 facilities. Applying the reduction factor to these generators results in 1,258 managing facilities being affected by each of these wastestreams.

This weighting process may place inappropriate emphasis on some of the wastestreams and facilities because facilities generating multiple wastestreams will be reflected more frequently than those generating a single stream.

5.1.3 Waste Management Assumptions

EPA uses simplified models of waste management for the baseline and post-regulatory cases. These assumptions are consistent with the approach the Agency has taken in developing the mismanagement scenario for the TC. In the baseline, EPA assumes that unregulated wastes are managed in new, unlined units -- non-wastewaters are managed in landfills, and wastewaters are managed in surface impoundments. This assumption has allowed the RIA to build directly on the analytic effort undertaken to develop distributions of DAFs, and to use those DAFs in simulating exposures and risks. It also allows the use of simplifying assumptions to correlate waste characteristics to leachate quality, as described below. And as described above, the Agency has developed methods to correlate regulation of generators (which the rule directly affects) with benefits that accrue at land disposal facilities (where the principal environmental damages posed by TC wastes are most likely to occur).

To analyze the regulatory options, EPA assumes a regulated waste is properly managed in Subtitle C units and that proper management results in negligible ground-water contamination. Thus, the analysis assumes that all of the baseline risk and resource damage posed by wastes are eliminated if those wastes are regulated by the TC.

5.1.4 Simulation of Exposure Concentrations and Plume Areas

EPA modeled risk and resource damage for all of the wastes that were characterized across a spectrum of hydrogeologic and exposure situations. This was accomplished with a Monte Carlo model that combined information on the distribution of waste characteristics with information on the distribution of environmental and exposure conditions associated with managing these wastes, and calculated the risk and resource damages resulting from their management. It is important to take note of the fact that once the specific portion of a wastestream to be regulated by the TC is determined using the "cost-driving" constituent described in Chapter 2, the Agency models benefits using risk-driving constituents only.[3] "Cost-driving" constituents themselves are not used in the risk calculations.

In the model, leakage from a facility is assumed to be immediate and the extent of leakage is measured in terms of steady-state contaminant concentrations and steady-state contaminated plume areas in the underlying ground water. This subsection describes the stochastic model that calculates the exposure concentrations and plume areas upon which the risk and resource damage estimates are based. Subsection 5.1.5, which follows, describes the methods used for calculating risk and resource damage.

The model produces exposure concentrations and plume areas reflecting variations in wastestream concentrations and a range of hydrogeologic conditions. This is accomplished, in part, by developing many individual synthetic wastestreams for each of the characterized wastes. There is a four step sequence that produces exposure concentrations and plume areas for each wastestream:

- Determine waste concentrations of risk-driving constituents from distributions of concentrations;
- Determine leachate concentrations of risk-driving constituents;
- Determine exposure concentrations; and
- Determine area of the contaminated plume.

This sequence of calculations is performed 250 times for each wastestream. After this number of iterations, the mean health risk and resource damage estimates for a waste of a particular characterization have stabilized (i.e., do not change significantly with additional iterations). The steps are described below and in more detail in Appendix D.

Waste Concentrations. The model randomly selects a percentile concentration value to be used in selecting appropriate waste concentrations for each iteration. The same percentile value is used to determine the concentration for the carcinogenic risk-driver and the non-carcinogenic risk-driver. For example, on the 43rd iteration for a particular wastestream the model may select the 17th percentile concentration value; the actual concentration for the carcinogenic risk driver would be the 17th percentile value as determined by the statistical distribution for that particular contaminant in that wastestream. The actual concentration for the non-carcinogenic risk driver would also be the 17th percentile value, based on its own statistical distribution of values. Note that the concentration distributions for constituents in wastewaters are surface impoundment influent concentrations and do not incorporate volatilization or other avenues for contaminant loss.

Leachate Concentrations. The leachate concentrations are determined from the waste concentrations. If the waste is a wastewater, the leachate concentration is the same as the waste concentration. If the waste is a non-wastewater, the Organic Leaching Model (OLM) is applied to the waste concentration to yield the leachate concentration. (The OLM is discussed in Section 2.2.1.)

---

[3] Note that the cost-driving constituent and the risk-driving constituent may actually be identica in some cases.

Exposure Concentrations. The model calculates exposure concentrations from the leachate concentrations by accounting for the dilution and attenuation that occurs between the source of leakage and an exposure point. This is accomplished by randomly selecting DAFs from a distribution of DAFs. The distribution of DAFs is taken directly from the output of EPA's EPACML model, and is identical for all 25 constituents modeled in the RIA. Each DAF corresponds to a particular hydrogeologic setting and a particular distance to the nearest point of exposure. The DAFs reflect steady-state conditions.

Plume Areas. The model calculates plume areas from leachate concentrations. The plume areas are based on an EPA model which predicts the surface area of the contaminated groundwater plume as a function of the ratio between initial (leachate) concentration and the specified downgradient concentration. (See Appendix E for a description of this methodology). The basic output of this model is expressed as a table showing plume surface area corresponding to each of a series of different concentration ratios.

The plume areas in this table represent steady-state conditions, and are based only on median values for hydrogeologic parameters. Thus, unlike the exposure concentrations, the plume areas do not account for variability in hydrogeology.

5.1.5 Estimation of Health Risk, Resource Damage, and Cleanup Costs

This subsection describes the methods and assumptions used to calculate the human health risk and resource damage based on exposure concentrations and contaminated plume areas. It also describes the methods and assumptions for estimating cleanup costs. Human health risk is measured in terms of risk to the most exposed individual (i.e., MEI) and population risk. Resource damage is measured in terms of the dollar value to replace contaminated water supplies. Cleanup cost is measured in terms of the dollar value to clean up groundwater to meet applicable cleanup targets.

In all cases, the description in this subsection is for predicting baseline damages. Under the regulatory options, these damages are assumed to be eliminated when a waste is regulated. The approach for calculating damages under the regulatory options is described more fully in subsections 5.1.6 and 5.1.7.

MEI Risk

MEI risk is based on the constituent concentrations at the closest downgradient well, if one is present. If downgradient wells are not present, there is no exposure and no MEI risk. Based on information from the Municipal Landfill Survey, EPA assumes that 54 percent of the managing facilities do not have downgradient wells.

For those facilities with downgradient wells, carcinogenic and non-carcinogenic MEI risk are estimated from the lifetime daily doses of the constituents calculated from the exposure concentrations. The doses assume daily ingestion of 2 liters of the ground water for 70 years (the average lifetime) by a 70 kilogram person. Carcinogenic MEI risk is calculated with a one-hit model using the dose and a risk potency factor for the constituent. Non-carcinogenic MEI risk is measured in terms of the ratio of the dose to the RfD for the constituent. Appendix D describes the specific models.

Population Risk

Population risk is also estimated for those scenarios with downgradient wells (i.e., 46 percent of the scenarios[4]). Population risk is based on the number of people affected by the contaminated plume and is calculated separately for exposure to carcinogens and non-carcinogens.

EPA uses the results of the plume area analysis rather than the results of the MEI risk modeling to generate estimates of population risk. Thus, the population risk estimates are based on a hydrogeologic scenario that corresponds to the median values for each of the parameters in the EPACML, i.e., hydrogeologic variability is not accounted for by this approach.

Based on results from the Municipal Landfill Survey, EPA assumes that 1.6 people per acre are affected by the dose calculated for each portion of the plume. EPA also assumes a 60 meter buffer strip between each facility and the exposed population. The 60 meter value was chosen to be consistent with the assumptions employed in EPA's Liner Location Model, and is in the middle of the distribution of such values that was developed for the Cross-Regulatory Analysis of land disposal programs.

Carcinogenic population risk is estimated in terms of the expected number of cancer cases. This is determined by estimating the individual risk resulting from the contaminated plume and multiplying it by the affected population. Because the risk levels decrease as one proceeds further downgradient and further from the plume centerline, individual risk is calculated for different portions of the plume.

Non-carcinogenic population risk is estimated in terms of the population exposed above the RfD for the constituent. Based on the plume area exhibiting a dose above the RfD, EPA estimates the number of people exposed above the RfD by assuming a population density of 1.6 people per acre.

Resource Damage

Resource damage measures the cost associated with replacing contaminated ground water that had been used as a source of drinking water. Resource damage represents the cost of replacing an existing water supply source (i.e., groundwater downgradient of a waste management facility) with a substitute source of drinking water. The cost of the substitute drinking water supply is taken to be an approximation of the economic value of the groundwater resource prior to contamination. The resource damage estimates are based on the costs of designing and constructing an alternative water supply which meets the demand of the population with contaminated water.[5]

---

[4] The 46 percent figure was taken from EPA's Municipal Landfill Survey, and reflects populations near municipal landfills.

EPA uses the following assumptions for the major components of the resource damage approach:

Area of contaminated plume. The contaminated plume area is the area exhibiting concentrations above the thresholds defining the suitability of the water for use. EPA uses thresholds based on drinking water standards (i.e., MCLs) when they exist and alternatively the lower of taste and odor thresholds or health-based thresholds (with the health-based thresholds limited by detection limits). Exhibit 5-4 presents the thresholds for the constituents examined in this analysis. EPA determines steady-state plume areas based on these thresholds for both carcinogenic and non-carcinogenic risk-driving constituents, when both types of constituents are present in a wastestream. EPA uses the larger of the two plumes to calculate resource damage.

Source of replacement water. EPA assumes that alternative water will be available in each situation from a ground-water source within one mile of the contaminated source. This replacement scenario is the least costly of the likely alternatives. The other alternatives include more distant ground water, nearby surface water, or more distant surface water.

Use scenario. EPA calculates resource damage under two scenarios. For the 46 percent of the facilities with existing downgradient wells, EPA assumes the entire population within the plume uses the contaminated water, and EPA calculates a "use" value which is the replacement cost for water currently in use. For the 54 percent of the facilities without downgradient wells, EPA assumes the population retains the option to use the water as a drinking water source in the future, and EPA calculates an "option" value. The option value weights the resource damage by the probability the resource will be used in the future. EPA assumed that the probability of use would increase by approximately 1.6 percent per year, based on U.S. Geological Survey water supply summaries in the early 1980s (which indicated this annual rate of increase for ground-water withdrawals overall). The resource damage results reflect both types of values.

Number of people affected. Based on results from the Municipal Landfill Survey, EPA assumes a population density of 1.6 people per acre in the vicinity of each facility. EPA uses this assumption both for existing populations and for those which retain the option to use the water in the future. The total number of people affected is equal to the area of the plume (i.e., groundwater contaminated at concentrations exceeding the threshold) times the population density.

Period of Operation. EPA assumes that the contaminated water is replaced immediately and will be required for 200 years.

---

[5] ICF Incorporated, "OSWER Comparative Risk Project: Ground-Water Valuation Task Force Report. Draft", Prepared for U.S. EPA, Office of Underground Storage Tanks, February 4, 1988.

EXHIBIT 5-4
RESOURCE DAMAGE THRESHOLDS FOR THE TC CONSTITUENTS a/

Constituent	Carcinogen Class	Resource Damage Threshold (mg/l)	Source of Threshold
1,1-Dichloroethylene	C	.007	MCL
1,2-Dichloroethane	B2	.01	detection limit
2,4,5-Trichlorophenol	N	4.0	health-based
2,4,6-Trichlorophenol	B2	.05	detection limit
2,4-Dinitrotoluene	B2	.25	detection limit
Benzene	A	.005	MCL
Carbon Tetrachloride	B2	.005	MCL
Chlordane	B2	.0005	detection limit
Chlorobenzene	N	.1	odor threshold - B
Chloroform	B2	.06	health-based
Heptachlor	B2	.0001	detection limit
Hexachlorobenzene	B2	.025	detection limit
Hexachlorobutadiene	C	.006	odor threshold - A
Hexachloroethane	C	.01	odor threshold - A
Methyl Ethyl Ketone (MEK)	N	1.0	odor threshold - A
Nitrobenzene	N	.025	detection limit
Pentachlorophenol	N	.3	taste threshold - B
Pyridine	N	.1	odor threshold - A
Tetrachloroethylene	B2	.01	detection limit
Trichloroethylene	B2	.005	MCL
Vinyl Chloride	A	.001	MCL
m-cresol	N	.25	odor threshold - B
o-cresol	N	.26	odor threshold - B
p-cresol	N	.055	odor threshold - B
p-Dichlorobenzene	C	.075	MCL

---

[a] Resource Damage thresholds are MCLs if they exist, or the lower of the taste and odor threshold or the health-based threshold based on a risk level of 10^{-5} with the health-based threshold at least as large as the detection limit.

[b] The references for the taste and odor thresholds are as follow:

A - Handbook of Environmental Data for Organic Chemicals, Verschueren, Von Nostrand Reinhold, 1983.

B - "Compilation of Odour Threshold Values in Air and Water," National Institute for Water Supply, Voorburg, Netherlands, Central Institute for Nutrition and Food Research TNO, Zerst, Netherlands, pages 37-50, June 1987.

C - Oil and Hazardous Materials - Technical Assistance Data Systems (OHM-TADS), Database prepared by U.S. Environmental Protection Agency, Oil and Special Materials Controls Division, Office of Water Program Operations, Washington, D.C. 1983.

Cleanup Costs

This section describes the methodology used to estimate cleanup costs in the absence of regulation of TC wastes. In general, this methodology assumes that a portion of the facilities managing potential TC wastes will require cleanup. Without TC regulation, the cleanup will be performed with public funds, either at the state or local levels or through Superfund. With TC regulation, a portion of these cleanup costs will be avoided. Further descriptions of the cleanup cost scenario and the estimation of an average site cleanup cost are provided below.

Cleanup Cost Scenario. EPA assumes cleanup is required at facilities managing potential TC wastes which have downgradient wells and substantial ground-water contamination. The Agency assumed that those facilities with sufficient ground-water contamination to exceed $1 million (present value) in resource damage would warrant cleanup. To allow for growth and detection of the plumes, EPA assumes that cleanup will begin 15 years hence, and all costs are discounted accordingly at an annual rate of 3 percent.

Average Cleanup Cost. EPA estimated an average per site cleanup cost of $15 million using Superfund Record of Decision (ROD) data. The Agency examined RODs from 1986 and 1987 which listed TC constituents as the primary constituents of concern and which required groundwater remediation. EPA examined only relatively recent RODs in order to reflect the preference for permanent remedies resulting from the Superfund Amendments and Reauthorization Act (SARA). Exhibit 5-5 provides information on the subset of RODs used to estimate the average cleanup cost. These costs may understate the actual costs of cleanup, since they do not include any expenses (private, state, or local) incurred prior to the Superfund evaluation of the sites.

These costs are similar to estimates of the cost of a typical cleanup estimated in the National Contingency Plan (NCP) RIA.[6] The NCP RIA estimated that an average Superfund-like cleanup would require an initial capital cost of $14.7 million and annual O&M costs of $394,000. These estimates are based on 30 RODs signed between FY 1982 and FY 1986. The NCP RIA stated that there was no information to determine how representative these 30 RODs are of all ROD sites.

5.1.6 Determination of Which Wastes Are Regulated in Each Option

By performing the preceding steps, EPA established the level of health risks, resource damages, and cleanup costs in the baseline. For each of the wastestreams described in Section 5.1.1, EPA had computerized data sets containing the following information for each of the 250 iterations of the model:

---

[6] U.S. EPA, "Regulatory Impact Analysis in Support of the Proposed Revisions to the National Oil and Hazardous Substances Pollution Contingency Plan," Office of Solid Waste and Emergency Response, prepared by ICF Incorporated, 1988.

EXHIBIT 5-5

RECORD OF DECISION DATA USED TO ESTIMATE AVERAGE CLEANUP COSTS

Site	Year of ROD	Constituents of Concern	Cleanup Cost (1988 dollars)
Ottati & Goss	87	VOCs, acid and base neutral compounds, pesticides, metals	43,900,000
Gold Coast	87	TCE, PCE, VOCs, and metal	5,334,000
Sodyeco Site	87	TCE, PAHs, and VOCs	3,981,000
Geiger (C&M Oil)	87	arsenic, toluene, organics, PCB, and metals	8,061,000
Palmetto Wood Preserving	87	pentachlorophenol, chromium, and arsenic	1,569,000
Seymour Recycling	87	VOCs, organics, TCE, DEE, benzene, toluene, and metals	750,000
FMC Corporation	87	TCE, PCE, benzene, toluene, and other VOCs	1,519,000
Conservation Chemical	87	inorganics, organics, VOCs, metals, and dioxin	21,400,000
Colbert Landfill	87	VOCs, TCA, and TCE	24,700,000
Blosenski Landfill	86	VOCs and inorganics	24,900,000
Coleman Evans	86	PCP and other VOCs	3,700,000
Syncon Resins	86	VOCs and chlordane	10,300,000
Tinkham Garage	86	VOCs and TCE	10,900,000
Union Pacific	86	Creosote and PCPs	48,700,000
Average			14,978,000

- waste concentration (this is an input, drawn from a distribution of concentrations)
- the number of facilities represented by the iteration (calculated as the total number of facilities managing the wastestream divided by 250)
- leachate concentration (equal to waste concentration for wastewaters, calculated by using the Organic Leaching Model for non-wastewaters)
- MEI risk (cancer and non-cancer)
- Population risk (cancer and non-cancer)
- Resource damage
- Cleanup cost.

EPA manipulated these data sets to establish the level of benefits attributable to each of the regulatory options.

The Agency determined which wastes are regulated in each option. Specifically, based on the cost analysis (described in Section 3), the Agency determined the proportion of each wastestream that is regulated under each set of DAFs by comparing leachate concentrations to regulatory levels. EPA then sorted each of the wastestream data sets based on leachate concentration. Because the concentrations of the risk-driving constituents are assumed to be directly correlated to the concentrations of the cost-driving constituent, the highest risk-driving constituent concentrations would be the first to be regulated; e.g., if 10 percent of the wastestream was regulated (based on comparing cost-driver leachate concentrations to the regulatory level), then the top 10 percent of risk-driver leachate concentrations would be regulated.

That portion of each wastestream regulated under each option is assumed to be managed in Subtitle C-compliant units after regulation. As previously mentioned, EPA assumes that Subtitle C management results in essentially eliminating the baseline damages.

Thus, to create estimates of the post-regulatory damages for each option, the Agency "zeroed out" the baseline risks, resource damage, and cleanup cost for each iteration where the leachate concentration was above the level that would be regulated.

5.1.7 Determination of Reductions in Risk, Resource Damage, and Cleanup Costs

The final step in the methodology involved aggregating information across wastestreams for each option. The risk, resource damage, and cleanup cost estimates for each iteration were weighted by the number of managing facilities, and summed across all wastestreams.

In the ensuing discussion of results, the Agency discusses benefits in terms of the difference between baseline damages and post-regulatory damages, i.e., the extent of human health risk avoided, resource damage avoided, and cleanup costs avoided.

5.2 RESULTS

This section presents the results of the benefits analysis for the baseline case and for each of four regulatory options. An overview of the basic characteristics of the baseline, and the general patterns of the results for the regulatory options are presented in section 5.2.1. The distinctions between the baseline and the various regulatory options are discussed in more detail for each of the measures considered in our analysis in sections 5.2.2 through 5.2.8. This section concludes with a qualitative analysis of the effects of the TC on used oils.

5.2.1 Overview

Summary information for the baseline and for regulatory options with DAFs of 33, 100, 250, and 500 is presented in Exhibit 5-6; results are reported for six different measures covering carcinogenic risk, non-carcinogenic exposures, and resource damages. Similar information is presented separately for wastewaters and non-wastewaters in Exhibits 5-7 and 5-8.

Both wastewaters and non-wastewaters make significant contributions to the baseline damages for five of the six measures EPA considered. (All of the non-carcinogenic exposures exceeding the reference dose in the baseline are attributable to wastewaters.) However, wastewaters and non-wastewaters are affected much differently across the various regulatory options. For most measures, all four of the regulatory options reduce the damages posed by wastewaters to essentially zero; the greatest residual damage, even under the DAF 500 option, is 3 percent of the baseline value (as measured in terms of the number of facilities with cancer risks exceeding 10^{-5}). Benefits attributable to the different regulatory options vary much more for non-wastewaters, as shown in Exhibit 5-8.

The specific results are largely determined by a limited number of contaminants from just a few different wastestreams in particular SICs. For example, benzene from the Wholesale Petroleum Marketing SIC dominates baseline risk for both measures of carcinogenic risk and for both measures of resource damage. Wastewater (Stormwater Runoff and Tank Water Draws) and non-wastewater (Unleaded Gasoline Tank and Crude Oil Tank Cleaning Sludges) wastestreams provide the major benzene exposures in this SIC.

Similarly, pentachlorophenol dominates baseline risk for both measures of non-carcinogenic risk. The principal source for pentachlorophenol is the Sawmill and Planing Mill SIC, specifically the Treated Wood Drippage Wastewater wastestream.

This overview continues with a summary of results for each of the benefits measures.

Number of additional cancer cases in 70 years. There are 5.6 cases of cancer predicted in the baseline case. These are divided roughly evenly between wastewaters and non-wastewaters. The most stringent option (DAF 33) eliminates all of these cancer cases. The least stringent option (DAF 500) reduces the baseline figure by 93 percent; the residual risk is due to non-wastewaters.

EXHIBIT 5-6

SUMMARY OF BASELINE RISK AND REGULATORY BENEFITS FOR ALL WASTES

BENEFIT MEASURE (UNITS)	BASELINE RISK	BENEFIT FOR REGULATORY OPTION*			
		DAF 33	DAF 100	DAF 250	DAF 500
CANCER CASES (NUMBER OF CASES) OVER 70 YEARS	5.6	5.6	5.5	5.5	5.2
FACILITIES WITH CANCER RISK > 10E-5 (NUMBER OF FACILITIES)	790	790	780	730	460
PEOPLE EXPOSED TO NON-CARCINOGENIC CONSTITUENT CONCENTRATION > RFD (NUMBER OF PEOPLE)	320	320	320	320	320
FACILITIES WITH NON-CARCINOGENIC CONSTITUENT EXPOSURE > RFD (NUMBER OF FACILITIES)	8.2	8.2	7.6	5.7	5.7
RESOURCE DAMAGE (BILLION DOLLARS)	3.8	3.8	3.8	3.6	2.4
FACILITIES WITH RESOURCE DAMAGE > 10E6 DOLLARS (NUMBER OF FACILITIES)	1600	1600	1600	1600	1600

*ALL REGULATORY OPTION RESULTS ARE REPORTED AS REDUCTION FROM BASELINE RISK (i.e. BENEFIT)

EXHIBIT 5-7

SUMMARY OF BASELINE RISK AND REGULATORY BENEFITS FOR WASTEWATERS

BENEFIT MEASURE (UNITS)	BASELINE RISK		BENEFIT FOR REGULATORY OPTION*			
			DAF 33	DAF 100	DAF 250	DAF 500
CANCER CASES (NUMBER OF CASES) OVER 70 YEARS	2.9		2.9	2.9	2.9	2.9
FACILITIES WITH CANCER RISK > 10E-5 (NUMBER OF FACILITIES)	300		300	300	290	290
PEOPLE EXPOSED TO NON-CARCINOGENIC CONSTITUENT CONCENTRATION > RFD (NUMBER OF PEOPLE)	320		320	320	320	320
FACILITIES WITH NON-CARCINOGENIC CONSTITUENT EXPOSURE > RFD (NUMBER OF FACILITIES)	5.8		5.8	5.8	5.7	5.7
RESOURCE DAMAGE (BILLION DOLLARS)	1.4		1.4	1.4	1.4	1.4
FACILITIES WITH RESOURCE DAMAGE > 10E6 DOLLARS (NUMBER OF FACILITIES)	770		770	770	770	770

*ALL REGULATORY OPTION RESULTS ARE REPORTED AS REDUCTION FROM BASELINE RISK (i.e. BENEFIT)

EXHIBIT 5-8

SUMMARY OF BASELINE RISK AND REGULATORY BENEFITS FOR NON-WASTEWATERS

BENEFIT MEASURE (UNITS)	BASELINE RISK		BENEFIT FOR REGULATORY OPTION*			
			DAF 33	DAF 100	DAF 250	DAF 500
CANCER CASES (NUMBER OF CASES) OVER 70 YEARS	2.7		2.7	2.7	2.6	2.3
FACILITIES WITH CANCER RISK > 10E-5 (NUMBER OF FACILITIES)	490		490	490	440	170
PEOPLE EXPOSED TO NON-CARCINOGENIC CONSTITUENT CONCENTRATION > RFD (NUMBER OF PEOPLE)	0		0	0	0	0
FACILITIES WITH NON-CARCINOGENIC CONSTITUENT EXPOSURE > RFD (NUMBER OF FACILITIES)	2.5		2.5	1.9	0	0
RESOURCE DAMAGE (BILLION DOLLARS)	2.4		2.4	2.4	2.2	0.96
FACILITIES WITH RESOURCE DAMAGE > 10E6 DOLLARS (NUMBER OF FACILITIES)	800		800	800	790	780

*ALL REGULATORY OPTION RESULTS ARE REPORTED AS REDUCTION FROM BASELINE RISK (i.e. BENEFIT)

Number of facilities with cancer risk to the most exposed individual exceeding 10^{-5}. In the baseline case 790 facilities are estimated to pose cancer risks greater than 10^{-5}. (This represents about 7.5% of the 10,500 Subtitle D landfills, land application units, and industrial surface impoundments.) Non-wastewaters account for 62 percent of the total baseline risk. Benzene accounts for more than 90 percent of the baseline risk. While the most stringent regulatory option brings all 790 facilities beneath the 10^{-5} threshold, the less stringent options provide lesser degrees of protection. The DAF 500 option reduces the baseline value by 58 percent (with nearly all of the residual due to non-wastewaters); the DAF 250 option reduces that value by 92 percent; a DAF of 100 provides a 99 percent reduction.

Number of individuals exposed to non-carcinogens at levels above the reference dose. In the baseline case, there are 320 individuals with exposures that exceed the reference dose for non-carcinogenic substances. All of the regulatory options presented here prevent all of these exposures. Over 70 percent of the baseline cases are due to pentachlorophenol, and nearly all are associated with exposures from wastewaters.

Number of facilities with exposures to non-carcinogens for the most exposed individual exceeding the reference dose. Exposures exceeding the reference dose for non-carcinogens are predicted to occur at 8.2 facilities.[7] Nearly 70 percent of these facilities appear because of pentachlorophenol, and more than 70 percent that overall value are due to exposures from wastewaters. The most stringent regulatory option brings exposures at all facilities below the reference dose level. The less stringent options (DAFs 250 and 500) provide only 70 percent of this protection, and do not bring maximum exposures below the threshold for any of the facilities that appear in the baseline because of non-wastewater exposures.

Resource damage. Resource damages in the baseline case are estimated to be $3.8 billion. Non-wastewaters comprise 63 percent of that amount, and benzene is the constituent responsible for 95 percent. While the most stringent regulatory options reduce resource damage by nearly 100 percent, the least stringent option provides only a 63 percent reduction and leaves $1.4 billion in damages (essentially all from non-wastewaters.) The DAF 100 and DAF 250 options reduce resource damage by 100 percent and 95 percent, respectively.

Number of facilities with resource damage exceeding $1 million. In the baseline, 1600 facilities are predicted to have resource damages exceeding $1 million. Almost all of these cases are eliminated by any of the regulatory options presented in this document. (About 2 percent of the non-wastewater contribution to the baseline remains under the DAF 500 option.) The baseline cases are about evenly divided between wastewaters and non-wastewaters, and 94% are attributable to benzene contamination.

---

[7] Fractional facilities, like fractional cancer cases, are statistical projections produced by the methodology and are not meant to be taken literally.

Cleanup costs avoided. EPA estimates avoided cleanup costs at $15 billion for DAFs 33 through 500. This represents the elimination of all baseline cleanup costs, and reflects the fact that even the DAF 500 option reduced resource damage below the $1 million cutoff for substantially all facilities.[8]

5.2.2 Cancer Cases

EPA evaluated the differences between the various regulatory options in reducing number of cases of cancer over a 70 year period; there is at most a 7 percent difference in benefits between regulatory options. Detailed information on the constituents, SICs, and wastestreams contributing to baseline risk are presented in Exhibits 5-9, 5-10, and 5-11.

The 5.6 cases of cancer in the baseline are primarily attributable to exposures to benzene (63 percent), vinyl chloride (23 percent) and carbon tetrachloride (13 percent). The Wholesale Petroleum Marketing SIC poses 52 percent of this risk, with lesser amounts from Plastics Materials and Resins (21 percent) and Organic Chemicals (14 percent). Two Wholesale Petroleum Marketing wastestreams provide half of the total risk (41 percent from Stormwater Runoff and Tank Water Draws, and 9 percent from Unleaded Gasoline Tank Cleaning Sludge.) Two Plastics Materials and Resins wastestreams (both PVC sludges) each also provide 9 percent of this risk.

The DAF 33 option reduces the baseline risk to essentially zero. The DAF 100 and DAF 250 options reduce the baseline value by 98 percent, and the DAF 500 option reduces it by 93 percent. Essentially all of the differences between the regulatory options are from changes in benzene exposure in the Wholesale Petroleum Marketing SIC. All of the regulatory options address the baseline cancer cases due to wastewaters completely.

5.2.3 Facilities with Cancer Risk exceeding 10^{-5}

EPA evaluated the differences between the various regulatory options in reducing the number of facilities posing cancer risks above 10^{-5} to the most exposed individual. Detailed information on the constituents, SICs, and wastestreams contributing to baseline risk are presented in Exhibits 5-12, 5-13, and 5-14.

The 790 facilities with cancer risks exceeding 10^{-5} in the baseline are primarily attributable to exposures to benzene (91 percent) and tetrachloroethylene (6 percent). The Wholesale Petroleum Marketing SIC provides 68 percent of this total, with the next largest amount (16 percent) from the Miscellaneous Plastics Products SIC. Three Wholesale Petroleum Marketing wastestreams provide 68% of the total (33 percent from Stormwater Runoff and Tank Water Draws, and 18 percent each from Unleaded Gasoline Tank Cleaning Sludge and Crude Oil Tank Cleaning Sludge.) Oily Machinery and Lube Wastes, a Miscellaneous Plastics Products wastestream, provides an additional 16 percent.

---

[8] There are slight differences in cleanup costs avoided for the various regulatory options. Benefits under the DAF 500 option are approximately 1 percent below the full baseline amount, but rounding to two significant figures yields $15 billion for both values.

EXHIBIT 5-9

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT BY CONSTITUENT FOR CANCER CASES						
CONSTITUENT	BASELINE RISK (CANCER CASES)		CANCER CASES AVOIDED			
			DAF 33	DAF 100	DAF 250	DAF 500
BENZENE	3.5		3.5	3.4	3.4	3.1
VINYL CHLORIDE	1.3		1.3	1.3	1.3	1.3
CARBON TETRACHLORIDE	0.7		0.7	0.7	0.7	0.7
TETRACHLOROETHYLENE	0.1		0.0	0.0	0.0	0.0
2,4-DINITROTOLUENE	0.0		0.0	0.0	0.0	0.0
CHLOROFORM	0.0		0.0	0.0	0.0	0.0
HEPTACHLOR	0.0		0.0	0.0	0.0	0.0
2,4,6-TRICHLOROPHENOL	0.0		0.0	0.0	0.0	0.0
TRICHLOROETHYLENE	0.0		0.0	0.0	0.0	0.0
HEXACHLOROBENZENE	0.0		0.0	0.0	0.0	0.0
P-DICHLOROBENZENE	0.0		0.0	0.0	0.0	0.0
TOTAL	5.6		5.6	5.5	5.5	5.2

EXHIBIT 5-10

BASELINE RISK AND REGULATORY BENEFIT SUMMARY BY SIC CODE FOR CANCER CASES

SIC**	BASELINE RISK (CANCER CASES)		CANCER CASES AVOIDED			
			DAF 33	DAF 100	DAF 250	DAF 500
517	2.9		2.9	2.9	2.9	2.8
2821	1.2		1.2	1.2	1.2	1.2
286	0.8		0.8	0.8	0.8	0.8
OVERALL TOTAL*	5.6		5.6	5.5	5.5	5.2

*TOTALS MAY NOT ADD DUE TO ROUNDING OR BECAUSE SICS WITH MINOR CONTRIBUTIONS ARE NOT LISTED

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 5–11

WASTESTREAMS WITH SIGNIFICANT CONTRIBUTIONS TO CANCER RISK

WASTE NAME	SIC*	WASTE TYPE**	PERCENTAGE OF BASELINE RISK	PERCENTAGE OF REGULATORY BENEFIT DAF 100	PERCENTAGE OF REGULATORY BENEFIT DAF 250
STORM WATER RUNOFF AND TANK WASTE WATER DRAW	517	WW	41	41	42
POLYVINYL CHLORIDE SLUDGE/COAGULATION	2821	NW	9	9	9
POLYVINYL CHLORIDE SLUDGE/SEDIMENTATION	2821	NW	9	9	9
UNLEADED GASOLINE TANK CLEANING SLUDGE	517	NW	9	9	9
AGGREGRATE SLUDGE/ COAGULATION/FLOCCULATION	286	NW	7	7	7
AGGREGRATE SLUDGE SEDIMENTATION	286	NW	3	3	3
CRUDE OIL TANK CLEANING SLUDGE	517	NW	3	3	3
OILY MACHINERY AND LUBE WASTES	3079	NW	2	2	2

*SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

**WW=WASTEWATERS, NW=NON-WASTEWATERS

EXHIBIT 5-12

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT BY CONSTITUENT FOR NUMBER OF FACILITIES WITH MEI CANCER RISK > 10E-5

CONSTITUENT	BASELINE (NUMBER OF FACILITIES)	REDUCTION IN NUMBER OF FACILITIES WITH CANCER RISK > 10E-5			
		DAF 33	DAF100	DAF 250	DAF 500
BENZENE	720	720	720	710	440
TETRACHLOROETHYLENE	41	41	36	5	9
CARBON TETRACHLORIDE	13	13	13	12	12
VINYL CHLORIDE	5	5	5	5	5
HEPTACHLOR	4	4	4	0	0
TRICHLOROETHYLENE	3	3	3	3	0
CHLOROFORM	2	2	1	0	0
2,4-DINITROTOLUENE	1	1	1	1	1
2,4,6-TRICHLOROPHENOL	0	0	0	0	0
HEXACHLOROBENZENE	0	0	0	0	0
P-DICHLOROBENZENE	0	0	0	0	0
TOTAL*	790	790	780	730	460

*TOTALS MAY NOT ADD DUE TO ROUNDING

EXHIBIT 5-13

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT BY, SIC CODE, FOR NUMBER OF FACILITIES WITH MEI CANCER RISK > 10E-5

SIC**	BASELINE (NUMBER OF FACILITIES)		REDUCTION IN NUMBER OF FACILITIES WITH MEI CANCER RISK > 10E-5			
			DAF 33	DAF 100	DAF 250	DAF 500
517	540		540	540	540	400
3079	130		130	130	130	0
225X	33		33	28	0	0
2911	20		20	20	12	12
461	18		18	18	18	16
286	15		15	15	15	13
2821	12		12	12	7	5
283X	10		10	10	8	8
2992	8		8	8	5	3
2231	4		4	4	0	0
226X	3		3	3	3	0
26XX	2		2	1	0	0
2824	1		1	1	1	1
2822	1		1	1	1	1
OVERALL TOTAL*	790		790	780	730	460

*TOTALS MAY NOT ADD DUE TO ROUNDING OR BECAUSE SICS WITH MINOR CONTRIBUTIONS ARE NOT LISTED

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 5-14

WASTESTREAMS WITH SIGNIFICANT CONTRIBUTIONS TO THE NUMBER OF FACILITIES WITH MEI CANCER RISK > 10E-5

WASTE NAME	SIC*	WASTE TYPE**	PERCENTAGE OF BASELINE RISK	PERCENTAGE OF REGULATORY BENEFIT DAF 100	PERCENTAGE OF REGULATORY BENEFIT DAF 250
STORMWATER RUNOFF AND TANK WASTE WATER DRAWS	517	WW	33	33	35
UNLEADED GASOLINE TANK CLEANING SLUDGE	517	NW	18	18	19
CRUDE OIL TANK CLEANING SLUDGE	517	NW	18	18	19
OILY MACHINERY AND LUBE WASTE	3079	NW	16	16	17

*SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

**WW-WASTEWATERS, NW-NON-WASTEWATERS

The DAF 33 option eliminates substantially all of the baseline situations where cancer risk exceeds 10^{-5}, and DAF 100 reduces 99 percent of them. While the DAF 250 option reduces the total by 92 percent, the DAF 500 option controls only 58 percent of those cases, leaving 330 facilities exceeding that risk level. All but 10 of those remaining facilities manage non-wastewaters. As is typical for the results, the primary differences between the regulatory options are due to distinctions among non-wastewaters for the dominant SICs and the most frequently occurring risk-driving constituents (for this measure of benefits, benzene and tetrachloroethylene.)

The 10^{-5} risk level is a common benchmark, but it is important to consider the performance of the various regulatory options at other risk levels as well. Exhibit 5-15 shows a plot of exceedance probabilities (which equate to the number of managing facilities in our methodology) against risk, on a log scale, for the baseline case and each of the regulatory options. The uppermost curve shows the numbers of facilities posing various levels of risk in the baseline case. All of the regulatory options plot below and to the left of the baseline case, showing significant reductions in the number of facilities at each risk level, and clear reductions in the risk posed by the worst facilities. Note that the differences between the regulatory options are more pronounced at the 10^{-6} risk level than at 10^{-5}. Across a wide range of risks, however, the DAF 100 and DAF 250 options provide similar results. The DAF 500 option provides less risk reduction than the DAF 100 or DAF 250 options across a wide risk range; the DAF 33 option provides greater risk reduction across that range. However, all of the regulatory options show reductions in risk from the baseline case.

5.2.4 Individuals With Non-cancer Exposures Above the Reference Dose

All of the regulatory options from DAF 33 through DAF 500 eliminate all of the non-cancer exposures above the reference dose in the baseline. Detailed information on the constituents, SICs, and wastestreams contributing to baseline risk are presented in Exhibits 5-16, 5-17, and 5-18.

Across all managing facilities, the total population exposed to doses above the RfD is 320. All of these exposures in the baseline are attributable to wastewaters. These are primarily from exposures to pentachlorophenol (71 percent) from Treated Wood Drippage Wastewater in the Sawmill and Planing Mill SIC, and methyl ethyl ketone (29 percent) in two Organic Chemicals SIC wastestreams. (26 percent of this MEK is from the wastestream known as "MEK from Dehydrogenation," and an additional 3 percent is included in "Acetic Anhydride from Pyrolysis/Dehydration.")

EXHIBIT 5–15

Carcinogenic MEI Risk

Wastewater and Non – Wastewater

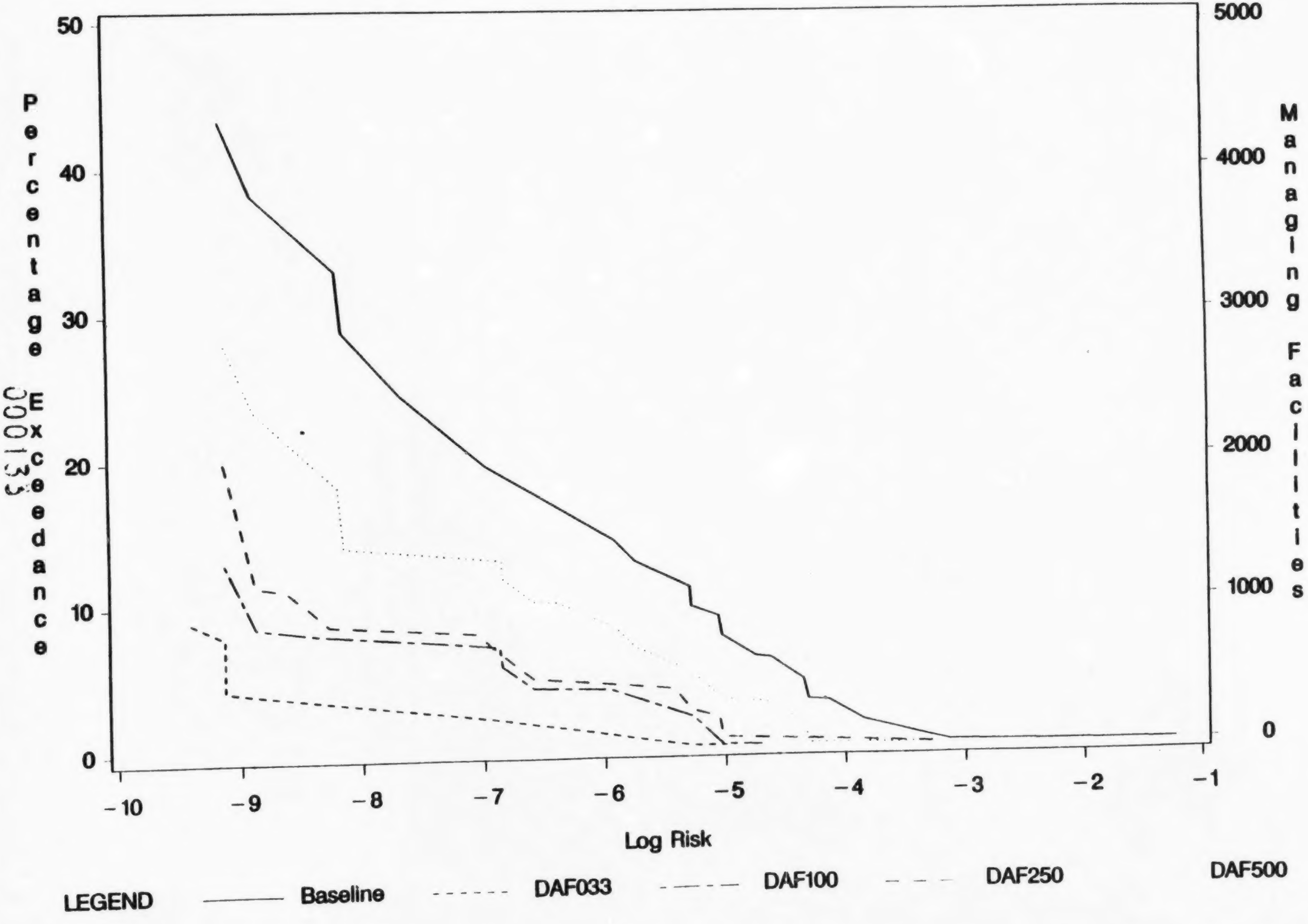


EXHIBIT 5-18

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT, BY CONSTITUENT, FOR POPULATION EXPOSED TO NON-CARCINOGENIC CONSTITUENT CONCENTRATION > RFD

CONSTITUENT	BASELINE EXPOSURES		REDUCTION IN POPULATION EXPOSED TO NON-CARCINOGENIC CONCENTRATION > RFD			
			DAF 33	DAF 100	DAF 250	DAF 500
PENTACHLOROPHENOL	230		230	230	230	230
METHYL ETHYL KETONE (MEK)	93		93	93	93	93
CHLOROBENZENE	0		0	0	0	0
O-CRESOL	0		0	0	0	0
TOTAL*	320		320	320	320	320

*TOTALS MAY NOT ADD DUE TO ROUNDING

EXHIBIT 5-17

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT, BY SIC, FOR POPULATION EXPOSED TO NON-CANCER CONSTITUENT CONCENTRATION >RFD

SIC**	BASELINE EXPOSURES		REDUCTION IN POPULATION EXPOSED TO NON-CANCER CONSTITUENT CONCENTRATION > RFD			
			DAF 33	DAF 100	DAF 250	DAF 500
2421	230		230	230	230	230
286	93		93	93	93	93
OVERALL TOTAL*	320		320	320	320	320

*TOTALS MAY NOT ADD DUE TO ROUNDING OR BECAUSE SICS WITH MINOR CONTRIBUTIONS ARE NOT LISTED

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 5–18

WASTESTREAMS WITH SIGNIFICANT CONTRIBUTIONS TO NON-CANCER RISK					
WASTE NAME	SIC*	WASTE TYPE**	PERCENTAGE OF BASELINE RISK	PERCENTAGE OF REGULATORY BENEFIT DAF 100	PERCENTAGE OF REGULATORY BENEFIT DAF 250
TREATED WOOD DRIPPAGE WASTE WATER	2421	WW	71	71	71
METHYL EHTYL KETONE FROM DEHYDROGENATION	286	WW	26	26	26
ACETIC ANHYDRIDE FROM PYROL/DEHYDRATION	286	WW	3	3	3

*SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

**WW=WASTEWATERS, NW=NON-WASTEWATERS

5.2.5 Facilities with Non-Cancer Exposures above the Reference Dose

EPA evaluated the differences between the various regulatory options in reducing the number of facilities where the most exposed individual would receive exposures exceeding the reference dose for a non-carcinogenic contaminant.[9] Detailed information on the constituents, SICs, and wastestreams contributing to non-cancer MEI risks are presented in Exhibits 5-19, 5-20, and 5-21.

The 8.2 facilities estimated to have such exposures in the baseline primarily manage pentachlorophenol (68 percent), methyl ethyl ketone (26 percent) and chlorobenzene (7 percent). The Sawmill and Planing Mill SIC provides 68 percent of this risk (through the Treated Wood Drippage wastestream), with 20 percent from the Plastics Materials and Resins SIC (the Alkyd Resins Filter Residuals wastestream), 7 percent from the Reclaimed Rubber SIC (via a pair of treatment sludge wastestreams), and 6 percent from the Organic Chemicals SIC.

The DAF 33 option eliminates all of the baseline cases, and the DAF 100 option eliminates 93 percent. Both the DAF 250 and DAF 500 options reduce this value by only 70 percent, leaving exposures above the reference dose at an estimated 2.5 facilities. This difference is due to non-wastewater wastestreams. The wastestream posing highest risk (Treated Wood Drippage) is a wastewater that is almost completely regulated by all of the regulatory options. All of the other high-risk wastestreams are non-wastewaters. They are completely regulated at DAF 33; they are virtually uncontrolled at DAF 250 and DAF 500; at DAF 100 they are partially controlled.

While the reference dose is a key benchmark for non-carcinogenic exposures, exposures below the reference dose are of interest as well. Exhibit 5-22 shows a plot of exceedance probabilities (which equate to the number of managing facilities in our methodology) against the ratio of MEI exposure to the reference dose (on a log scale) for the baseline case and each of the regulatory options. On this log scale, a value of zero corresponds to a ratio of 1 (i.e., the predicted dose is equal to the reference dose); a value of 1 corresponds to a ratio of 10; and so on. The plot shows clearly that the vast majority of the model runs result in predicted exposures well below the reference dose.

The uppermost curve shows the numbers of facilities posing various levels of exposure in the baseline case. All of the regulatory options are arrayed below and to the left of the baseline case, showing significant reductions in the number of facilities at each exposure level, and clear reductions in the exposures at the worst facilities in each of the regulated scenarios. As with carcinogenic risk, the DAF 100 and DAF 250 options provide similar results across a wide range of exposure levels. The DAF 500 option reduces fewer exposures and the DAF 33 reduces more, but all of the regulatory options show demonstrable reductions in exposures compared to the baseline case.

---

[9] The reason for the apparent inconsistency between the non-cancer results for populations versus MEIs is that the population estimates are derived using the plume area calculations (based on a single hydrogeologic setting) while the MEI estimates are derived using the full distribution of DAFs (based on variable hydrogeology and well locations).

EXHIBIT 5-19

SUMMARY OF BASELINE RISK AND REGULATORY BENEFITS, BY CONSTITUENT, FOR NUMBER OF FACILITIES WITH NON-CANCER MEI EXPOSURE > RFD						
CONSTITUENT	BASELINE (NUMBER FACILITIES)		REDUCTION IN NUMBER OF FACILITIES WITH NON-CARCINOGENIC MEI EXPOSURE > RFD			
			DAF 33	DAF 100	DAF 250	DAF 500
PENTACHLOROPHENOL	5.6		5.6	5.6	5.6	5.6
METHYL ETHYL KETONE (MEK)	2.1		2.1	2.1	0.1	0.1
CHLOROBENZENE	0.6		0.6	0.0	0.0	0.0
O-CRESOL	0.0		0.0	0.0	0.0	0.0
TOTAL*	8.2		8.2	7.6	5.7	5.7

*TOTALS MAY NOT ADD DUE TO ROUNDING

EXHIBIT 5-20

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT BY, SIC CODE, FOR NUMBER OF FACILITIES WITH NON-CANCER MEI EXPOSURE > RFD

SIC**	BASELINE (NUMBER OF FACILITIES)	REDUCTION IN NUMBER OF FACILITIES WITH EXPOSURE TO NON-CARCINOGENIC CONSTITUENT CONCENTRATION > RFD			
		DAF 33	DAF 100	DAF 250	DAF 500
2421	5.6	5.6	5.6	5.6	5.6
2821	1.6	1.6	1.6	0.0	0.0
3031	0.56	0.56	0.0	0.0	0.0
286	0.51	0.51	0.47	0.12	0.12
OVERALL TOTAL*	8.2	8.2	7.6	5.7	5.7

*TOTALS MAY NOT ADD DUE TO ROUNDING OR BECAUSE SICS WITH MINOR CONTRIBUTIONS ARE NOT LISTED

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 5–21

WASTESTREAMS WITH SIGNIFICANT CONTRIBUTIONS TO THE NUMBER OF FACILITIES WITH NON–CANCER MEI EXPOSURE >RFD

WASTE NAME	SIC*	WASTE TYPE**	PERCENTAGE OF BASELINE RISK	PERCENTAGE OF REGULATORY BENEFIT DAF 100	PERCENTAGE OF REGULATORY BENEFIT DAF 250
TREATED WOOD DRIPPAGE WASTE WATER	2421	WW	68	73	98
ALKYD RESINS FILTER RESIDUAL	2821	NW	20	21	0
COAGULATION/FLOCCULATION SLUDGE - RECLAIM	3031	NW	4	0	0
SEDIMENTATION SLUDGE RESIDUAL RUBBER	3031	NW	4	0	0
SPENT CATALYST - OXIDATION GLYCEROL/GL	286	NW	2	3	0

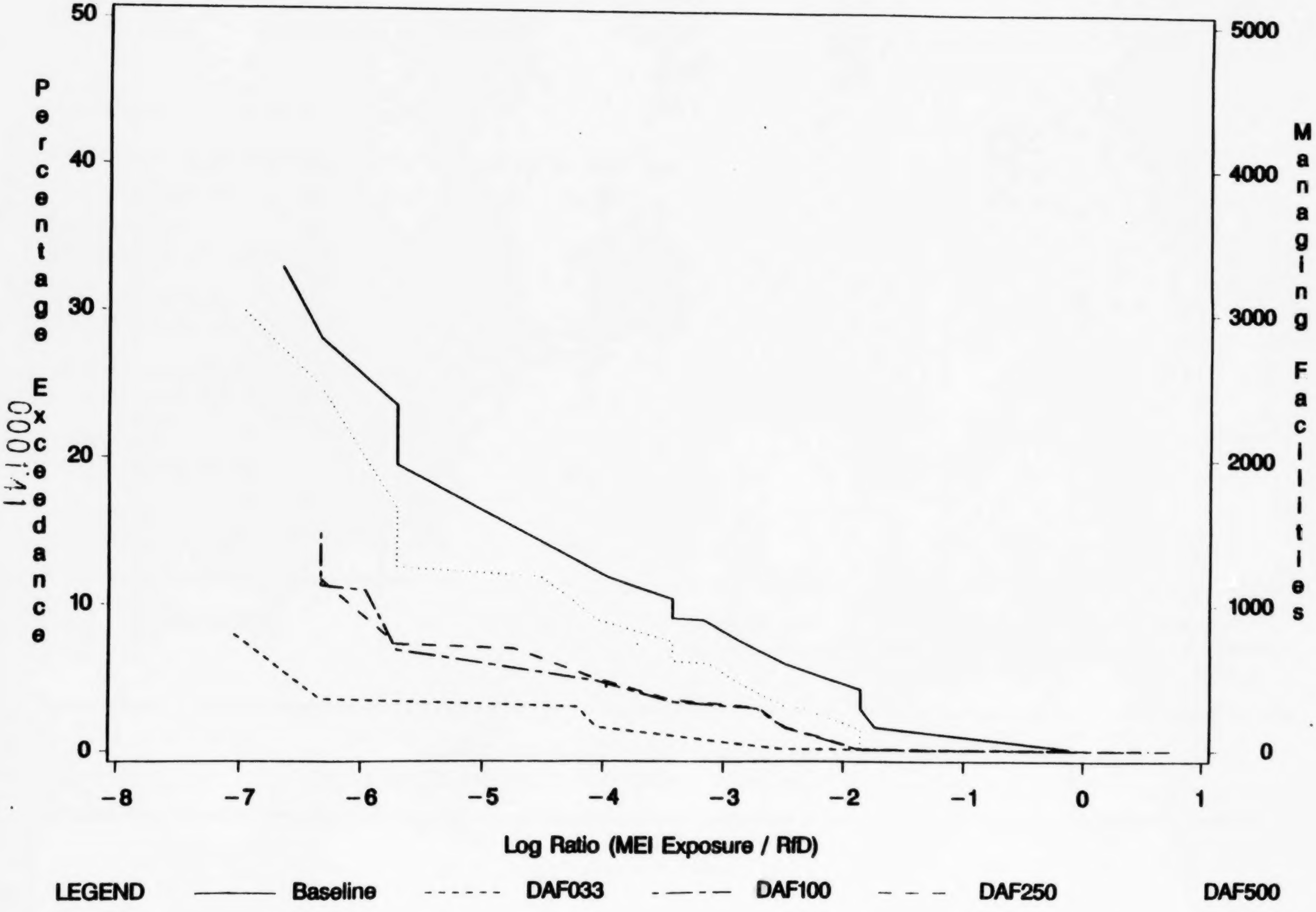
*SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

**WW=WASTEWATERS, NW=NON-WASTEWATERS

EXHIBIT 5-22

Non – Carcinogenic MEI Risk

Wastewater and Non – Wastewaters



5.2.6 Resource Damages

EPA evaluated the differences between the various regulatory options in reducing resource damage. Detailed information on the constituents, SICs, and wastestreams contributing to resource damages are presented in Exhibits 5-23, 5-24, and 5-25.

The $3.8 billion resource damage in the baseline is almost exclusively attributable to benzene contamination (95 percent). Wastewaters account for 37 percent of the baseline figure.

The Wholesale Petroleum Marketing SIC contributes 71 percent of the damage through three wastestreams (Stormwater Runoff and Tank Water Draws at 32 percent, Unleaded Gasoline Tank Cleaning Sludge at 21 percent, and Crude Oil Tank Cleaning Sludge at 18 percent). An additional 16 percent comes from the Miscellaneous Plastics Products SIC through the Oily Machinery and Lube Wastes wastestream.

Both the DAF 33 and DAF 100 options eliminate nearly all of the baseline risk. The DAF 250 option reduces this value by 95 percent. The DAF 500 option reduces it by only 63 percent, leaving $1.4 billion in resource damage. Damages from wastewaters (i.e., Stormwater Runoff and Tank Water Draws) are eliminated nearly completely under all of these regulatory options. The differences between regulatory options are from changes in benzene exposure from non-wastewater sources.

5.2.7 Facilities with Resource Damage Exceeding $1 Million

All of the regulatory options from DAF 33 through DAF 500 eliminated essentially all of the instances in the baseline where resource damage exceeds $1 million. Detailed information on the constituents, SICs, and wastestreams contributing to the baseline value are presented in Exhibits 5-26, 5-27, and 5-28.

The 1,600 facilities with resource damage in excess of $1 million are almost exclusively attributable to benzene contamination (94 percent). The Wholesale Petroleum Marketing SIC contributes 81 percent of the facilities with resource damage, roughly equally divided between two wastestreams (Unleaded Gasoline Tank Cleaning Sludge, and Stormwater Runoff and Tank Water Draws.) Wastewaters are responsible for 48 percent of the facilities that exceed this damage threshold in the baseline.

The reason that each of these regulatory options brings damages below the $1 million threshold is shown readily in Exhibit 5-29. This is a plot of exceedance probabilities (which equate to the number of managing facilities in our methodology) against resource damage, on a log scale, for the baseline case. The uppermost curve shows resource damages in the baseline case for the worst facilities. It has a clear "elbow" just above the $1 million mark, meaning that the number of facilities with more damage than that drops off very rapidly. Even the worst of those facilities do not have damages very far above $1 million, so modest measures can reduce resource damages at nearly all facilities below the $1 million threshold. The two additional curves are for the DAF 250 and DAF 500 options. The fact that these appear at all in this exhibit indicates that they do not address all of the resource damage in

EXHIBIT 5-23

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT, BY CONSTITUENT, FOR RESOURCE DAMAGE

CONSTITUENT	BASELINE RISK (DOLLARS)	RESOURCE DAMAGE AVERTED PRESENT VALUE			
		DAF 33	DAF 100	DAF 250	DAF 500
BENZENE	3,600,000,000	3,600,000,000	3,600,000,000	3,400,000,000	2,200,000,000
PENTACHLOROPHENOL	70,000,000	59,000,000	59,000,000	59,000,000	59,000,000
CARBON TETRACHLORIDE	54,000,000	54,000,000	54,000,000	54,000,000	53,000,000
VINYL CHLORIDE	22,000,000	22,000,000	22,000,000	20,000,000	20,000,000
TETRACHLOROETHYLENE	14,000,000	14,000,000	14,000,000	14,000,000	14,000,000
METHYL ETHYL KETONE (MEK)	11,000,000	11,000,000	11,000,000	5,800,000	840,000
TRICHLOROETHYLENE	5,400,000	5,400,000	5,400,000	2,800,000	0
CHLOROBENZENE	3,500,000	3,300,000	0	0	0
HEPTACHLOR	2,800,000	2,800,000	2,800,000	2,800,000	0
CHLOROFORM	2,200,000	2,200,000	2,200,000	2,200,000	800,000
2,4-DINITROTOLUENE	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
HEXACHLOROBENZENE	0	0	0	0	0
2,4,6-TRICHLOROPHENOL	0	0	0	0	0
P-DICHLOROBENZENE	0	0	0	0	0
TOTAL*	3,800,000,000	3,800,000,000	3,800,000,000	3,600,000,000	2,400,000,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

EXHIBIT 5–24

SUMMARY OF BASELINE RISK AND REGULATORY BENEFITS BY SIC CODE FOR RESOURCE DAMAGE

SIC**	BASELINE RISK (DOLLARS)		DOLLARS OF RESOURCE DAMAGE AVERTED PRESENT VALUE			
			DAF 33	DAF 100	DAF 250	DAF 500
517	2,700,000,000		2,700,000,000	2,700,000,000	2,700,000,000	2,000,000,000
3079	630,000,000		630,000,000	630,000,000	510,000,000	0
461	92,000,000		92,000,000	92,000,000	92,000,000	79,000,000
2911	74,000,000		74,000,000	74,000,000	72,000,000	66,000,000
286	72,000,000		72,000,000	72,000,000	71,000,000	66,000,000
2421	70,000,000		59,000,000	59,000,000	59,000,000	59,000,000
2821	50,000,000		50,000,000	50,000,000	40,000,000	20,000,000
283X	34,000,000		34,000,000	34,000,000	34,000,000	33,000,000
2992	14,000,000		14,000,000	14,000,000	14,000,000	14,000,000
226X	5,400,000		5,400,000	5,400,000	2,800,000	0
26XX	4,900,000		4,900,000	4,900,000	4,900,000	4,900,000
2824	3,500,000		3,500,000	3,500,000	3,500,000	3,500,000
3031	3,300,000		3,100,000	0	0	0
2823	3,000,000		3,000,000	3,000,000	3,000,000	3,000,000
2822	2,900,000		2,900,000	2,900,000	2,900,000	2,700,000
OVERALL TOTAL*	3,800,000,000		3,800,000,000	3,800,000,000	3,600,000,000	2,400,000,000

*TOTALS MAY NOT ADD DUE TO ROUNDING

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 5–25

WASTESTREAMS WITH SIGNIFICANT CONTRIBUTIONS TO RESOURCE DAMAGE

WASTE NAME	SIC*	WASTE TYPE**	PERCENTAGE OF BASELINE RISK	PERCENTAGE OF REGULATORY BENEFIT DAF 100	PERCENTAGE OF REGULATORY BENEFIT DAF 250
STORM WATER RUNOFF AND TANK WASTE WATER DRAW	517	WW	32	32	33
UNLEADED GASOLINE TANK CLEANING SLUDGE	517	NW	21	21	23
CRUDE OIL TANK CLEANING SLUDGE	517	NW	18	18	19
OILY MACHINERY AND LUBE WASTE	3079	NW	16	16	14
TREATED WOOD DRIPPAGE WASTE WATER	2421	WW	2	2	2
WASTE WATER (API AFFLUENT)	2911	WW	2	2	2

*SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

**WW–WASTEWATERS, NW–NON-WASTEWATERS

EXHIBIT 5–26

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT BY CONSTITUENT FOR FACILITIES WITH RESOURCE DAMAGE > 1 MILLION DOLLARS						
CONSTITUENT	BASELINE (NUMBER OF FACILITIES)		REDUCTION IN NUMBER OF FACILITIES WITH RESOURCE DAMAGE > 10E6 DOLLARS			
			DAF 33	DAF 100	DAF 250	DAF 500
Benzene	1500		1500	1500	1500	1500
Carbon Tetrachloride	30		30	30	30	30
Pentachlorophenol	28		28	28	28	28
Vinyl Chloride	12		12	12	12	12
Tetrachloroethylene	5		5	5	5	5
Methyl Ethyl Ketone (MEK)	4		4	4	2	0
Chlorobenzene	3		3	0	0	0
2,4–Dinitrotoluene	1		1	1	1	1
Chloroform	1		1	1	1	0
2,4,6–Trichlorophenol	0		0	0	0	0
Hexachlorobenzene	0		0	0	0	0
Heptachlor	0		0	0	0	0
Trichloroethylene	0		0	0	0	0
p–Dichlorobenzene	0		0	0	0	0
TOTAL	1600		1600	1600	1600	1600

EXHIBIT 5-27

SUMMARY OF BASELINE RISK AND REGULATORY BENEFIT FOR NUMBER OF FACILITIES WITH RESOURCE DAMAGE > 1 MILLION DOLLARS

SIC**	BASELINE (NUMBER OF FACILITIES)	REDUCTION IN NUMBER OF FACILITIES WITH RESOURCE DAMAGE > 1 MILLION DOLLARS			
		DAF 33	DAF 100	DAF 250	DAF 500
517	1,300	1,300	1,300	1,300	1,300
2911	62	62	62	62	57
461	52	52	52	52	52
286	37	37	37	37	35
2421	28	28	28	28	28
283X	19	19	19	19	19
2821	17	17	17	15	10
2992	5	5	5	5	5
3031	3	3	0	0	0
2823	2	2	2	2	2
2824	2	2	2	2	2
2822	2	2	2	2	2
26XX	1	1	1	1	0
OVERALL TOTAL*	1,600	1,600	1,600	1,600	1,600

*TOTALS MAY NOT ADD DUE TO ROUNDING OR BECAUSE SICS WITH MINOR CONTRIBUTIONS ARE NOT LISTED

**SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

EXHIBIT 5-28

WASTESTREAMS WITH SIGNIFICANT CONTRIBUTIONS TO THE NUMBER OF FACILITIES WITH RESOURCE DAMAGE > $ 1 MILLION

WASTE NAME	SIC*	WASTE TYPE**	PERCENTAGE OF BASELINE RISK	PERCENTAGE OF REGULATORY BENEFIT DAF 100	PERCENTAGE OF REGULATORY BENEFIT DAF 250
UNLEADED GASOLINE TANK SLUDGE	517	NW	44	44	44
STORMWATER RUNOFF AND TANK WATER DRAWS	517	WW	41	41	41
WASTE WATER (API AFFLUENT)	2911	WW	3	3	3
TREATED WOOD DRIPPAGE WASTE WATER	2421	WW	2	2	2

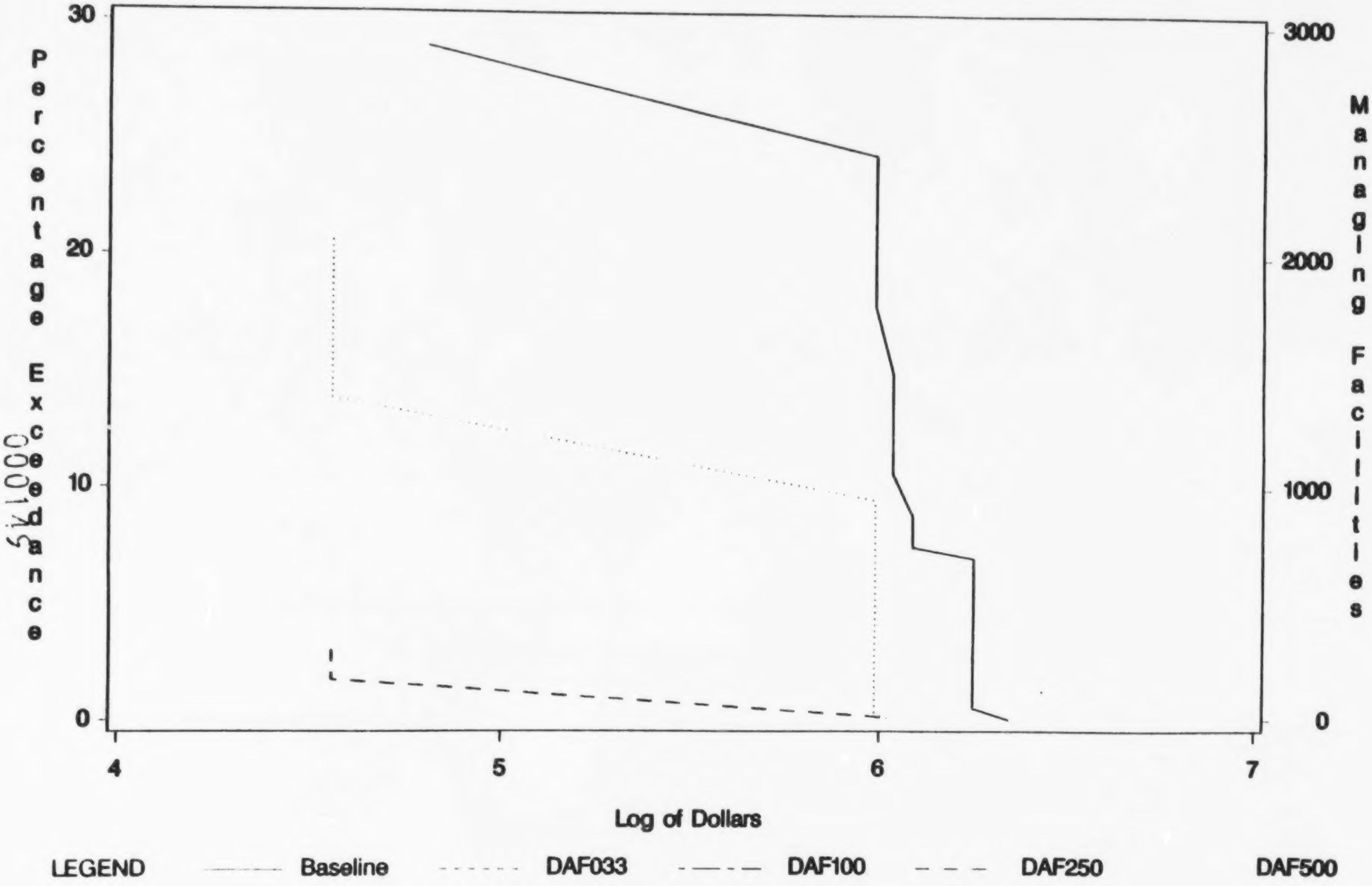
*SEE EXHIBIT 2-3 FOR SIC CODES CORRESPONDING TO DIFFERENT INDUSTRIES

**WW=WASTEWATERS, NW=NON-WASTEWATERS

EXHIBIT 5-29

Resource Damage

Wastewater and Non-Wastewater



Resource Damage equals zero for all Regulatory options the baseline (as DAF 33 and DAF 100 do.) However, both curves stop just short of the $1 million mark, showing that these options can leave some resource damages without broaching the $1 million threshold at any particular facility.

5.2.8 Cleanup Costs Avoided

Our simplified methodology calculates avoided cleanup costs on the basis of the number of facilities with resource damages exceeding $1 million. The approximately 1,600 facilities with damages above $1 million in the baseline, when multiplied by the $15 million per facility cleanup cost described in section 5.1 and discounted over 15 years, result in $15 billion as an estimate of baseline cleanup costs. EPA's results indicate all four of the DAFs eliminate essentially all such costs. Thus the avoided cleanup costs under all of the options considered in this document are approximately $15 billion.[10] Due to the simplified nature of this analysis, there is significant uncertainty associated with these estimates.

5.2.9 Benefits of Regulating Used Oil

This section discusses, in qualitative terms, the benefits that may result from the regulation of used oil by the TC. This supplementary analysis was done in conjunction with the cost analysis described in section 3.3.6. A more detailed discussion is provided in Appendix A.

Assuming that used oil would not create TCLP filtration problems, EPA found that virtually all used oil would fail the TC. EPA determined that three end-use management practices for used oil would be affected: landfilling/incineration, dumping, and road oiling. The oil managed in these practices would be shifted to other end-use management practices. For example, much of the used oil that is currently dumped or applied directly to roads by generators would probably be collected and sold to the used oil management system (UOMS). Firms in the UOMS that currently sell used oil for road oiling would generally shift this oil to other management practices, such as re-refining or burning as fuel. Used oil that is managed by landfilling or incineration in Subtitle D units would likely be shifted to management in Subtitle C units.

The shift in management practices could result in some benefits. Based on a very limited analysis of carcinogenic effects, it appears that eliminating the dumping of used oil would result in some benefits because other management practices (with the possible exception of burning in boilers) would present lower risks. Eliminating road oiling appears to have some benefits, particularly for reduction of ecotoxicity and for protection of groundwater. However, substitute management practices such as burning in boilers (or possibly disposal in landfills) may themselves contribute to exposure and risk in ways that are difficult to quantify, so net benefits from such management changes are also difficult to quantify.

---

[10] The various regulatory options do not produce identical answers. When rounded to two significant figures, however, each value is $15 billion.

5.3 LIMITATIONS OF THE METHODOLOGY

There are many uncertainties inherent in estimating health risks and resource damage. These uncertainties arise from data limitations such as the variability in wastes, waste management practices, waste management environments, and risk assessment factors. This section discusses factors introducing uncertainty into the benefits estimates and whether these factors underestimate or overestimate benefits.

The Methodology is Based on a Steady-state Model. The steady-state model does not consider the volume of waste being managed at any particular facility. Assuming that the contaminated plume grows immediately leads to overestimates for risk and resource damage because it may take many years for contaminant plumes to reach equilibrium size.

No Current Contamination. EPA's methodology assumes that all units newly regulated under the TC rule will avoid all contamination, thus avoiding 100 percent of baseline risk. This can overstate benefits for existing units, where some degree of contamination may already have occurred.

Median Hydrogeologic Conditions. The use of plume areas representing a single, 50th percentile hydrogeologic environment does not capture the full range of variability of actual hydrogeologic environments. This creates uncertainty in benefits estimates for population risk, resource damage, and cleanup cost.

Discrete Plume Areas. The use of a discrete plume area distribution (rather than a continuous one) contributes some additional error to benefits estimates. The resource damage, non-cancer exposure, and carcinogenic risk analyses employ different conventions for choosing a plume area when calculations fall between two listed values. However, the uncertainties contributed by the discrete plume distribution are not expected to be significant relative to other uncertainties associated with EPA's methodology.

Surface Impoundment Closures. The Agency's methodology assumes that potentially affected surface impoundment owner/operators will be able to switch to exempt tanks before the effective date of the TC rule; this may not be true. Facilities that do not make such a switch before that deadline will have to close as Subtitle C landfills, and will be subject to facility-wide corrective action. Although the relevant costs have been considered for these surface impoundments, the benefits have not been quantified and were not included in the benefits analyses. Thus, the reported estimates for benefits may be underestimated.

Assumptions About the Number of Managing Facilities. There is uncertainty about the actual number of facilities managing the wastewaters and non-wastewaters, and little is known about co-management of wastestreams. Also, the methodology specifically omits any benefits that might accrue at facilities that also have Subtitle C units on-site; the assumption of no unaddressed contamination at those units may not be correct, and this may cause the current results to underestimate benefits. Taken together, these uncertainties could result in underestimates or estimates of benefits.

Other Benefits. Additional benefits (e.g., reductions in ecorisk) may occur as a result of the TC rule. Thus the current analysis may underestimate benefits.

Wastewater Concentrations. Concentrations of the risk-driving constituents in wastewaters are based on influent concentrations. These concentrations may lead to overestimates of risk and resource damage because volatilization and other avenues for constituent loss are not considered.

Population Densities. Based on the Municipal Landfill Survey, EPA assumed uniform population densities in calculating population risk and resource damage. The results from the Survey may not be appropriate for all facilities managing TC wastes. This assumption may either underestimate or overestimate risk and resource damage.

Contaminants Considered. The risks estimated in this analysis take into account only the twenty-five constituents now considered for inclusion in the TC rule. Additional risks and resource damage may be expected to result from other constituents in wastestreams proposed for regulation under this rule. Also, the characterization of each wastestream by a single risk driver for cancer risks and a single risk driver for non-cancer exposures may have masked significant contributions by other contaminants included in the same wastestream, even if they are included in the proposed regulation. Significant additional benefits may accrue to the regulatory options considered, and baseline risks may be underestimates.

Responses to Contamination. The health benefits portion of EPA's methodology does not consider the possibility of detection and response to groundwater contamination. Taste and odor problems may alert populations at risk, or State or Federal monitoring programs may detect the contaminated plume. If contamination is discovered, residents may switch to bottled water or formal corrective action procedures may be initiated. Either prospect would reduce the actual health impacts of the contamination, and so the health benefits of the regulatory options considered in the current analysis may be overestimated.

Oily Wastes. The methodology assumes that oily wastes will be analyzed accurately by the TCLP and that benefits will result from the regulation of these wastes. However, it is possible that non-wastewaters with an oily component will not be properly identified as hazardous. A large proportion of facilities managing non-wastewaters and causing high risk may be managing oily wastes. Thus, the benefits of the TC rule for the regulation of non-wastewaters may be overstated.

Other Exposure Pathways. The methodology examines only one pathway for exposure, ingestion of groundwater. The model does not account for inhalation of air, ingestion of contaminated surface water, ingestion of contaminated fish, or adsorption through skin. Therefore, overall risks may be underestimated.

In other studies, EPA considered air risks from inhalation of airborne contaminants which have volatilized from potential TC wastewaters. These studies estimate MEI air risk (i.e., risk to an individual located 200 meters downwind from the facility). They show that in sectors other than Wholesale Petroleum Marketing, approximately 20 percent of modeled facilities had carcinogenic risk greater than 10^{-5}. However, MEI air risks from Wholesale Petroleum Marketing, a sector with a significant number of managing facilities, were less than 10^{-6}. These results reflect all of the wastewaters in the TC RIA database. They tend to be conservative estimates because (1) risks resulting from each constituent in a wastestream were summed to determine the total air risk associated with a wastestream and (2) wastewaters were assumed to be managed with little dilution (i.e., in surface impoundments ranging from .25 to 2 acres in area). More dilution may occur in practice.

Groundwater Discharge to Surface Water. The steady-state model used to develop estimates for the size of contaminated ground-water plumes does not consider the possibility of discharge to surface water. Particularly in the humid East, water tables tend to be close to the surface and contaminant plumes may be truncated by the discharge of contaminated groundwater to the surface. This suggests that the plume sizes used in the current analysis may be overestimates, and that estimates for carcinogenic population risk, non-cancer population exposure, and resource damage may also be overestimated.

Stimulus for Pollution Prevention. The current analysis assumes that the TC RIA database accurately reflects the wastes and wastestreams that will exist upon promulgation of the TC rule. It neglects the powerful stimulus that the TC rule may provide for facility owner/operators to enhance pollution prevention efforts.

Pollution prevention has merit on its own. Procedural changes to adopt less hazardous substitute chemicals or to begin closed-loop recycling would also reduce the health impacts and resource damages associated with current patterns of chemical use. Thus the benefits presented in this analysis may be somewhat underestimated.

5.4 SENSITIVITY ANALYSES

As described in previous chapters, EPA examined the sensitivity of waste volumes, number of facilities affected, costs, and economic impacts at DAF 100 to changes in certain analytical assumptions. EPA analyzed the sensitivity of the benefits analysis to many of the same factors. In addition, EPA performed sensitivity analyses on alternative population assumptions. These impacts are discussed below.

Effects of Sensitivity Analysis Factors Addressed in the Cost Analysis. EPA performed four sensitivity analyses on the cost of the TC rule (see Section 3.5). The implications for the benefits of the rule are discussed below.

> Percentage of Facilities Affected. As sensitivity analyses, EPA assumed first that 10 percent and then 90 percent of the facilities in each industrial sector are affected by the TC. EPA examined these alternative assumptions so as to vary the waste quantity generated by each facility. Because the benefits analysis is based on the number of managing facilities, and not the quantity of waste managed, this alternative does not affect benefits estimates.
>
> Wastewaters Managed in Surface Impoundments. EPA assumed all facilities generating wastewaters manage them on-site in surface impoundments as an alternative to using the number of managing facilities derived from the Screening Survey. The current assumption is that 1,900 facilities manage wastewaters (approximately 10 percent of the facilities generating wastewaters are estimated to manage wastes in surface impoundments.) The alternative assumption has a large

affect on the benefits analysis, multiplying the estimate of 1,900 by up to a factor of 10. The number of facilities causing significant risk, RfD exceedences, or resource damage would each increase correspondingly for wastewaters.

Distribution of Affected Waste Quantities to Large and Small Facilities. As a sensitivity analysis for costs, waste quantities were split equally between large and small facility size groups. This split was made as an alternative to splitting the waste quantity between small and large facility size groups based on value of shipments. This alternative split of waste quantities among facilities does not affect the benefits results since the benefits are not based on the quantity of waste handled, but on the number of sites managing the wastes. The number of sites managing the wastes would not be affected.

Waste Quantities Exhibiting the TC. EPA assumed the percentage of waste exhibiting the TC is based on the sum of percentages exceeding regulatory levels for all constituents as an alternative to being based solely on the cost-driving constituent. This assumption leads to higher estimates of wastes failing the TC. This assumption will affect the quantity of waste at each facility. It will not affect the results of the benefits analysis since these results are not based on quantity.

Benefits Results Using an Alternative Population Assumption. One of the major assumptions in the benefits analysis is that downgradient populations are present at only 46 percent of waste managing facilities. This value is taken from EPA's Municipal Landfill Survey and, therefore, reflects populations near municipal landfills. It may be an inaccurate representation of the presence of populations near generating facilities managing their wastes on site. This section re-examines the risk and resource damage results presented above assuming all facilities have downgradient populations. This determines the upper bound of the effects of this assumption. (Assuming that none of the facilities have downgradient wells would eliminate potential benefits and provide a lower bound.)

Assuming downgradient populations at all facilities increases the baseline damages by a factor of roughly 2.2 (i.e., 100 divided by 46), and correspondingly, increases the benefits by slightly more than a factor of two. For example, the total number of facilities with MEI cancer risk equal to 10^{-5} or greater in the baseline would increase from 790 to about 1710 (i.e., 790 times 2.2). The reduction in the number of high-risk facilities would be more than doubled, increasing from 780 (at DAF 100) to about 1690. Except for resource damage, all of the other benefit measures would increase linearly, as well. In calculating resource damage, EPA attributed some damages even when plumes are formed in the absence of existing populations (i.e., there is some "option value" as explained in Section 5.1); thus, the resource damage estimates for the baseline and regulatory options increase by a factor less than 2.2.

REFERENCES

(1) Regulatory Impact Analysis of Proposed Standards for the Management of Used Oil -- Prepared by Temple, Barker, and Sloane, Inc., for U.S. EPA, November 1985.

(2) 1982 Census of Manufactures, Volume II. Industry Statistics, U.S. Department of Commerce, Bureau of the Census.

(3) 1985 Annual Survey of Manufactures, Statistics for Industry Groups and Industries, U.S. Department of Commerce, Bureau of Census.

(4) Screening Survey of Industrial Subtitle D Establishments (Draft Final Report), U.S. EPA Contract 68-01-7359, December, 1987.

(5) Organic Leaching Model, U.S. EPA (51 FR 41084), November 13, 1986.

(6) Background Document on Subsurface Fate and Transport Model, U.S. EPA/OSW, 1988.

(7) Final Report, National Survey of Solid Waste (Municipal Landfill Facilities), U.S. EPA Office of Solid Waste, October, 1988.

(8) "Wastewater Treatment Profiles for Industrial Sectors Impacted by Proposed Toxicity Characteristic," EPA Contract No. 68-01-7287, Work Assignment No. 46. Memorandum to John-Goodrich Mahoney, U.S. EPA, from Midwest Research Institute, August 19, 1988.

(9) "Wastewater Treatment Profiles for Industrial Sectors Impacted by Proposed Toxicity Characteristic," EPA Contract No. 68-01-7287, Work Assignment No. 46, MRI Project No. 9101-L(46). Memorandum to John-Goodrich Mahoney, U.S. EPA, from Midwest Research Institute, August 24, 1988.

(10) Estimates of Waste Generation by Cellulosic Manmade Fibers, Synthetic Organic Fibers, Petroleum Refining, Rubber and Miscellaneous Plastics Products, Leather Tanning and Finishing, Oil and Gas Transportation Industries, and the Laundry, Cleaning, and Garment Services, Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, May 27, 1987.

(11) Estimates of Waste Generation by the Lumber and Wood Products Industry, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, December 9, 1987.

(12) Estimates of Waste Generation by the Organic Chemicals Industry, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, December 7, 1987.

(13) Estimates of Waste Generation for Petroleum Crude Oil and Petroleum Products Distribution and Wholesale Systems, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, November 13, 1987.

(14) Estimates of Waste Generation by the Petroleum Refining Industry, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, November 13, 1987.

(15) Estimates of Waste Generation by the Pharmaceutical Industry, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, November 16, 1987.

(16) Estimates of Waste Generation by the Pulp and Paper Industry, Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, August 12, 1987.

(17) Estimates of Waste Generation by the Synthetic Fibers Industry, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, November 16, 1987.

(18) Estimates of Waste Generation by Textile Mills, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, December 15, 1987.

(19) Synthetic Rubber Industry, Final Draft Report, prepared by Midwest Research Institute for U.S. EPA/Office of Solid Waste, November 24, 1987.

(20) Composition and Management of Used Oil Generated in the United States, prepared by Franklin Associates Ltd for U.S. EPA, September, 1984.

(21) Risk Assignment of Proposed Waste Oil Standards for the Management of Used Oil, prepared for U.S. EPA Office of Solid Waste Economic Analysis Staff, August 7, 1985.